THE MODEL ENGINEER

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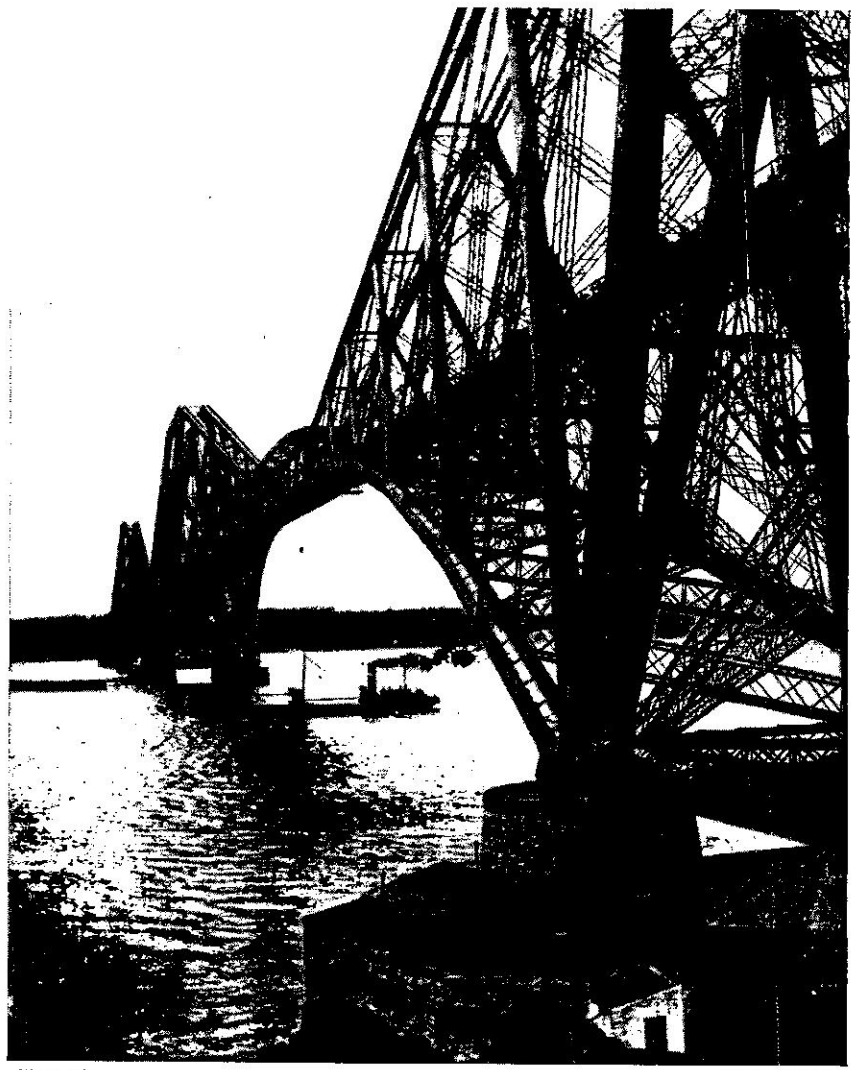

Photo by] *[C. B. Maycock*

An old friend from a less familiar angle — the Forth Bridge taken from North Queensferry, looking towards the south shore

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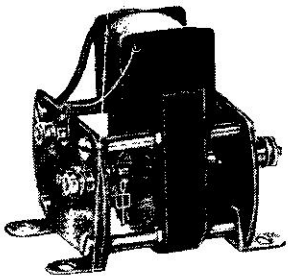

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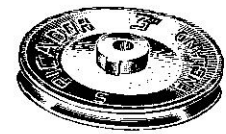

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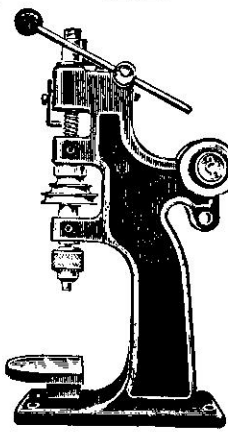

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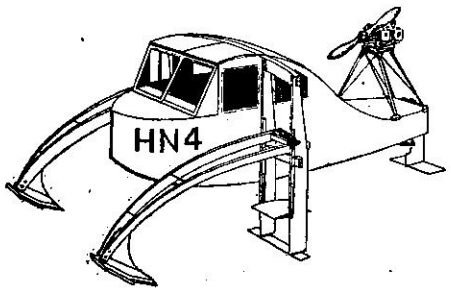

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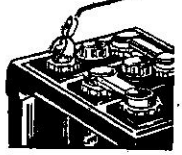

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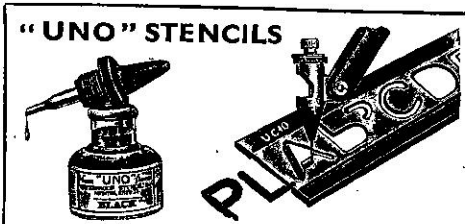

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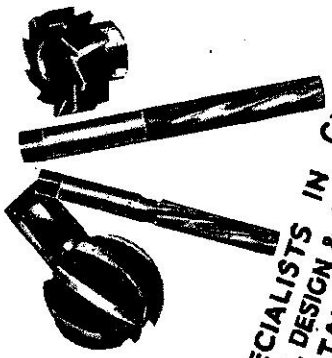

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THE
MODEL ENGINEER

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SMOKE RINGS

Exhibition Prizes

MORE than one of the prizes generously offered by friends of THE MODEL ENGINEER have a special interest beyond the recognition of handicraft skill. Mr. S. E. Stevens, the donor of the "Stevens Cup," for example, has a particular desire to encourage the modelling of steam engines other than locomotives. He writes :—" I sincerely hope that the Cup will be offered for the best stationary or marine engine conforming to real practice, as before. Model locomotives are well looked after, as also I.C. engines, and I do so want to give the former engines, stationary and marine, some encouragement. They have done so much for us in the past before the I.C. engine was ever invented. Are we any happier for this invention ? Otto never dreamt what it would lead to." Admiral Sir Reginald Bacon, whose handsome trophy, the " Admiral's Cup," should bring a sparkle to the eyes of lady competitors, desires in particular to encourage those loyal women workers who did such good service in the munition factories and who now find in model making not only an outlet for the mechanical skill they have acquired, but an enjoyable form of recreation for such leisure hours as their domestic duties permit. Mr. S. A. Walter strikes a new note with his offer of a Cup for a model of an unusual prototype ; we do not hear enough of these efforts out of the usual groove, some of which are exceptionally clever and interesting. Altogether the prize list is a record one this year. Some excellent entries have been coming in, and I hope that the competition section when finally staged at the Hall will be an outstanding tribute to the versatility and handicraft skill of the model engineers of this country. The judges, who will be appointed by the two Societies who are sharing in the management of the Exhibition, will have an interesting and, in some sections, a rather exacting duty, to perform.

London's Latest Outdoor Track

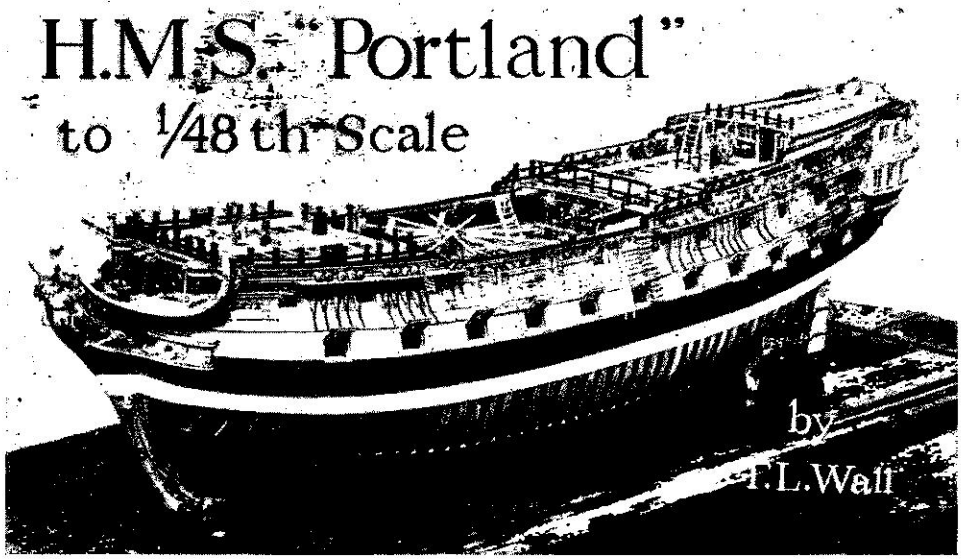
I HAVE recently had a pre-view of London's latest outdoor model railway track. It is being erected by the Malden Society, who have now, through the help of a member, obtained the lease of a private piece of ground with ample space for two tracks and for club buildings, and, possibly at a later date, a pool for power-boats. The ground is situated at Thames Ditton with an entrance in Claygate Lane. On one side it is bounded by the main line of the Southern Railway, and on the other by a narrow stream which itself has boating possibilities. At the time of my visit the first of the two tracks was in course of construction, Mr. R. J. P. Mew and other members having already carried out more than half the work. It is approximately oval in plan and is laid with three gauges giving a continuous run of 850 ft. The track is carried on reinforced concrete bearers supported on concrete pillars resting on substantial bases in the ground. Steam-raising sidings with a turntable are to be installed, and it is hoped that the track will be in running order at a very early date. The second track will be for larger gauge engines and will, it is expected, give a continuous run of over 1,200 ft. Plans are under consideration for suitable club premises which will be put in hand as and when building permits and materials are available. It is the intention of the Society to develop the ground as a rendezvous for all model engineers within reach, with ample facilities for meetings and locomotive and boat running. Locomotive owners who would like to try out their engines on the track will be welcomed at any time. Claygate Lane is almost immediately opposite the well-known premises of the Milk Marketing Board and the Malden Signboard indicates the entrance to the ground. The nearest railway stations are Hinchley Wood, Thames Ditton, and Surbiton, while there are no fewer than eight 'bus services within easy walking distance. Car-parking space is available.

Wood for Model Making

IN the course of a letter on the left-handed topic, Mr. R. J. Turner, a carpenter, says :—" By the way, why do not model boat builders use lime-tree wood for carving out their hulls ? This is a really lovely wood to work on, very little heavier than yellow pine, and it can be carved with a much better finish than pine. It can be obtained in small, large, or very large sizes from any home-grown wood yard or mill. Lime is also highly prized by wood carvers, who for their lovely hand tools use lilac for the handles, which is exactly like boxwood."

Percival Marshall

H.M.S. "Portland" to 1/48th Scale



ANYONE who writes on early shipbuilding is sticking out his chin, partly because the methods used were largely traditional and partly because many of those traditions were handed down from master to apprentice by word of mouth and example; consequently, at this period of time much is conjectural, and controversial.

Wooden ships were universal all over the world ever since the time when man first went adrift on a log until comparatively recent days, and that is a long time! And then, suddenly, almost in one generation, they gave place to iron and an entirely different method of building. During those hundreds of years building methods changed little and slowly; there were fewer essential differences between a ship of 1600 and a ship of 1800, than there were between a ship of 1800 and one of 1850. But the men who can build a modern whaler could build a reproduction of a Viking ship, the men who can build a destroyer could not.

The point of all that is that there are still yards round our coasts where wooden ships are built, yachts, fishing vessels, ship's lifeboats, and where the traditional methods of building are still followed, wood being just as much wood as it was in the days of 1066 and all that. It would be time very well spent for anyone keen on building ship models to spend a holiday near one of these yards; they are generally in delightful places, and to pass the time in the yard watching how things are done, one will learn more in a week than from a year of reading. Another point is that a model built on any of the short-cut methods, such as "digging out" or "bread and butter principle," is not the same and does not look the same as a model properly built, ship fashion; neither is there anything like the same fun and satisfaction in her building.

Books were written and information is available from Elizabethan times, though hard to come by; but anyone wishing to build a model of a ship of the 16th, 17th, or even 18th, centuries, with any pretence to accuracy will have to exercise a certain amount of imagination, and be prepared to defend himself.

The photographs are of a model built by the writer of H.M.S. *Portland*, a 50-gun ship of 1766. This ship was chosen because the original builder's drafts were available, either of *Portland* herself or of sister-ships in her class; also a painting of a model of the ship in South Kensington showing her colour and decoration. I am a novice in these things and the idea was that if one of the professors attacked me and said, "This was not so," I could produce the original draft and reply, "So what?" Sure enough, the professors did say that, and I replied accordingly. But it did not seem to make much difference; it never does with that lot!

These ships were sheep-dogs, designed mainly for convoy protection, because convoys were as vital to us during the Napoleonic wars as they were during the last two spots of bother.

They were 4th-rates, not frigates, and had to be fast enough to sail round a convoy and whip in, and heavily enough armed to beat off any raiding wolf of a French frigate. Even in those days, masters liked to sneak off on their own and had to be hustled back into line. Great, or for that matter, great plus, grandfather was remarkably like his great, or great plus, grandson, or vice versa.

Their heavier armament meant that these ships were not fast enough to catch those same Frenchmen; but then not many British frigates could do that, and anyway, their job was protection, not chasing round all over the ocean.

An interesting point about the painted frieze is that it is generally considered that no ships of the period smaller than first-rates had painted friezes, some authorities confine them to flagships; but one of the drafts worked from was a profile draft of *Bristol*, a sister-ship, and this draft gives full details of her painted frieze, nymphs and all, which is further confirmed by the portrait of *Portland* showing it in colours.

The model was build after the fashion of "Dockyard" models, *i.e.* without planking below the main wales, though the practice of building models in this way had probably gone out at the time *Portland* was built. The Navy Board at the Admiralty consisted mainly of fighting officers, as opposed to designers, and, as it is easier to tell what a ship will be like from a model than from drafts, the Admiralty ordered that, before any ship of force was laid down, a model should be built from the design and submitted to them for consideration. This custom held good during the 17th and much of the 18th centuries.

As the interior of a ship is as important as her lines, it was necessary that this should be seen, and it is suggested that the planking below the main wales was omitted in order to let light in from below and some of the deck planks left out in order that the lower decks could be seen. The planking would not be left to show construction, as the frames of these models were conventionalised in many respects and ships were not framed quite in that way.

Another point is that, during the period, the construction of wooden ships altered little and was well known to the members of the board; they would be much more concerned with whether there was room to fight the guns and whether she was likely to be a good sailer.

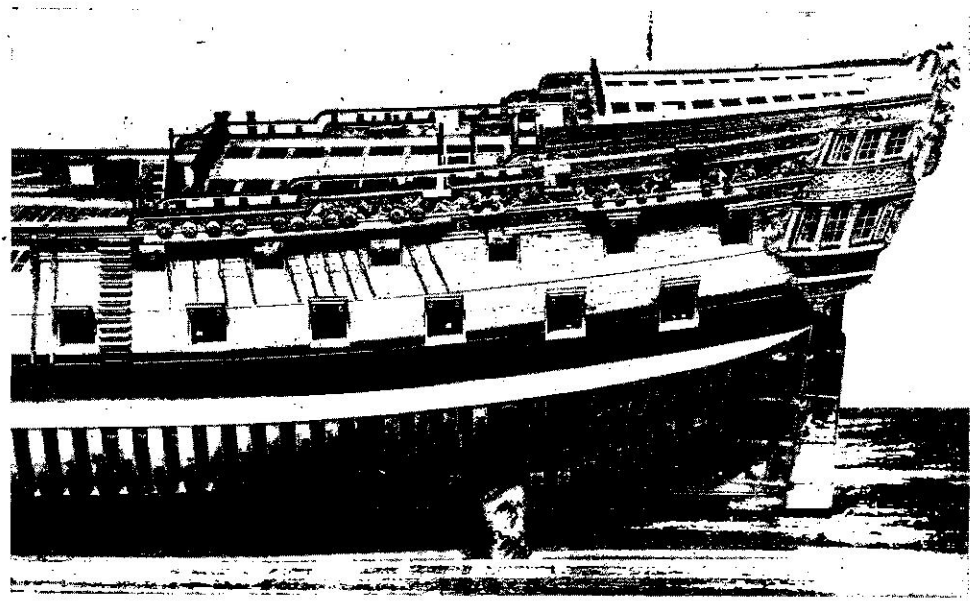
It would be difficult to produce anything better suited to its purpose than these dockyard models; a half-model sectioned down the fore and aft centre-line occurs to one, but such a model would not convey the same sense of reality, besides being more difficult to construct. It is easy from such as the dockyard models to visualise the ship it represents, and therein, perhaps, lies much of the charm of such models and the fascination in building them.

The models were built by shipwrights according to the traditions of their craft; that is to say, they were miniature ships, and where they depart from full size practice there is sure to be a good reason for it. It is possible that the deck planking which was omitted was the soft planking. The waterways and next few planks inboard were thicker stuff and gave extra strength to the hull; in fact they were part of the ship's skeleton and, as such, were included.

It should be remembered that these Navy Board models were models *for* a ship and not models *of* a ship, and it did not follow that ships would be built to that design; or, if built, they might be altered to fit in with orders by the Navy Board as a result of their examination of the model. Hence the difficulty sometimes in identifying models known to be genuine Navy Board models with actual ships.

The fore and aft thickness of the frames of a ship was laid down in "room and space" measurement and varied according to her size, or rate. In *Portland*, the thickness of frames was 14 in., called "room," and the frames were 2½ in. apart, called "space."

This space was maintained by seasoned oak blocks hammered in between the frames, and the frames were bolted together. So "room and space" was 16½ in. But the space between the frames is rarely found in models, the frames usually being hard up against each other; so, working to 1/48 scale or ¼ in. = 1 ft., the frames were made 11/32 in. thick and touching, thus keeping to the room and space measurement laid down, but making it all frame. Whether this was the dockyard method is not known to me, but it works. As the sides of the ports were frames, the framing draft must be followed to fit in with the ports; so this would seem to be a reasonable way of doing it. Where the framing



draft is not available, and it rarely will be, the positioning of the frames will have to be worked out from the position of the ports as shown on the sheer draft. This will give a pretty good idea of the thickness of frames necessary; but Sutherland gives the room and space measurements for the early 18th, and probably the latter part of the 17th, centuries.

1st rate.	2nd.	3rd.	4th.	5th.	6th.
ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft.
2 10	2 7	2 4.6/10	2 3	2 1	2

This does not fit in at all with *Portland's* 1 ft. 4½ in., but she is later than Sutherland's books and, as time went on, scantlings tended to get lighter; also, I took her measurements from the actual builder's draft. It is just one of those things one comes up against in this form of amusement and provides so much ammunition, or brick-bats, to the professors. I have not measured the thickness of the frames of *The Prince*, 1st rate, in South Kensington, but doubt if they are 11/16 in. Sycamore was the wood used throughout, but except that it was available and well seasoned, an important point, I do not know that there is any particular merit in it. One wants a hard wood without a marked grain; the harder the wood the easier to work and the more satisfactory the result. Box was the wood generally used in the old models, but is not easy to obtain in the sizes wanted and, though beautiful stuff to carve, is apt to burst, usually at the last, finishing cut.

The model was built on a thick ply-wood baseboard, planed true and with the stations, waterlines, etc., marked on it. If the baseboard is not true, or warps during the building of the model, the model cannot be true. I generally reckon that it takes one year per deck to build; that is, a frigate will take one year, a first rate three. But first rates are not much fun; for one thing, they are merely piling deck on deck, ditto repeato; for another, they look like floating haystacks when finished, if they ever are.

The keel was laid, stem and stern posts scarfed in and held vertical by iron angles screwed to the baseboard. The wood for the frames was machine-planed to 11/32 in. thickness. The sheer draft, or elevation, was divided up into 11/32 in. spaces, and the extra sections transferred to the draft; a tracing was then made and the sections numbered. In the tracing, the front of one frame or section was necessarily the back of the frame forward of it. The tracing was then placed over one of the pieces of sycamore true to the vertical and L.W.L. previously marked on the wood. The section required was pricked through, which gave the forward side of the frame, wood turned over, tracing transferred to the back and the next section pricked through, which gave the after side of the frame. As is usual in body plans, only half of each section was drawn, forward half on one side of the vertical centre-line, after half on the other. This meant the tracing had to be turned over to prick both sides of the frame, but ensured both sides being alike.

The frame was then cut out with a fret-saw to the larger section and pared down to the smaller, because almost all the frames were bevelled. Actually, all except the midship section, bevelled, in order to give the shape of the ship and the run of the planking; this bevel is considerable at stem and stern. They were not cut out inside at this stage. Obviously, care must be taken that the C.Ls. are true on both sides of the wood before the tracing is pinned down. After planing to thickness, my pieces for the frames were cut truly rectangular of a size sufficient to cover the largest section; this is no trouble to the mill, but saves a lot of trouble in building. A piece of cotton was stretched between stem and stern posts and the sections were screwed to the keel and to each other, the midship line on each section true to the cotton and checked by a square placed against the L.W.L. marked on baseboard touching the L.W.L. marked on the section. It is best to fasten in each section as it is cut, to save confusion, as many are much alike; also to check continually, not only with the square. The L.W.L. on the section should be vertically over the L.W.L. marked in plan on the baseboard, and, therefore, the square should touch both; but also check with a height gauge, the height being taken from the sheer draft.

When all this had been done, with the dead-wood at stem and stern in place, a solid hull was formed true to the drafts from the middle wale down. In this model, the frames were not carried above the middle main wale at this stage, as it was thought it would be easier not to. I am not sure that it was, but had to teach myself.

This solid hull was then sandpapered true and smooth and the top of the floor timbers, bottom of the lower and next futtocks marked in from the timbering draft. The hull was then taken apart, thwartships thickness of frames marked, tapering from about ⅜ in. at the keel to ¼ in. at the top. The centre was cut out to the smaller section and frames pared down inside to conform to the wider section, *i.e.* just the opposite to the outside of the frames. Care is necessary, as it is very easy to make a mistake and cut to the wider section, which means an entirely new frame; most annoying! Alternate frames were then cut at the top of the floor in one case and bottom of lower futtock in the other.

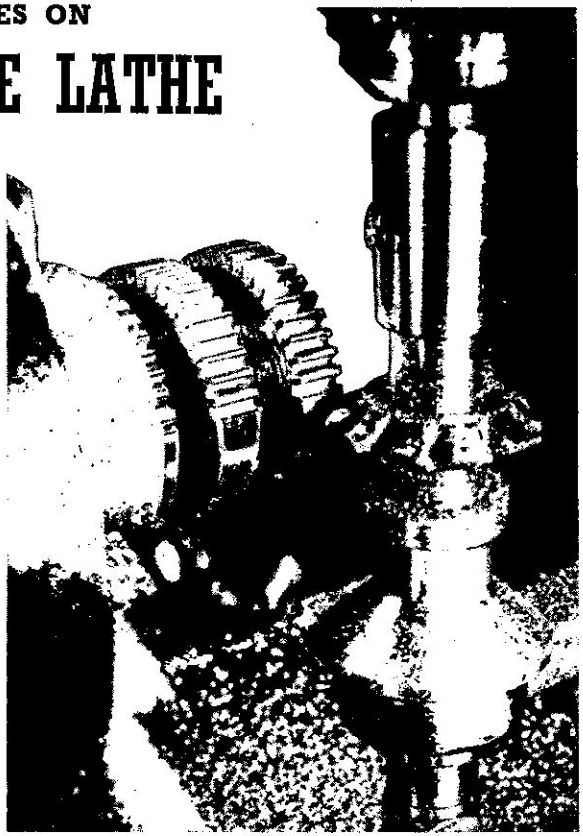
In those frames from which the floors had been cut, the lower futtocks were cut away, leaving part of the second futtocks. These floor pieces were screwed to the keel by screws with dowels on top to conceal the heads, and also screwed and glued to the frame or dead-wood in front of them. Above them the piece of second futtock was similarly fastened at the correct height above them. Then the next frame aft, which consisted of the first or lower futtock, was fastened to the floor in front, which it overlapped, and to the piece of second futtock at the top.

Examination of the photographs or of a dock-yard model will make clear what is a little difficult to describe. The short pieces of second futtocks were fastened to the frames in front to act as spacers at the top and to keep all the frames vertical and true; thus, the framing at the back of the main wales and a strip about half way down the frames was continuous. The bottom of the second futtocks in the model corresponds to the bottom of the white planking. This bit of

(*Continued on page* 57)

"NED" DISCOURSES ON

MILLING IN THE LATHE



A general review of the principles, appliances and methods employed for adapting the lathe for various types of milling operations

THE adaptability of the engineer's lathe is recognised by all intelligent users, and it is probably the most versatile of all machine tools, though in modern production engineering its duties tend to become more and more highly specialised as new machine tools for specific purposes are evolved. In a machine shop which is organised for the manufacture of a definite class of product, it is usually profitable to use a variety of machines, each specially designed to carry out a limited range of operations with the utmost efficiency, and thus versatility becomes a very dubious, or even a negative virtue. But in the machine shop which needs to be capable of tackling any class of work encountered, particularly where the number or variety of machine tools is limited, the ability to adapt any machine to purposes other than to that which it was primarily designed, is a most important practical asset.

It is not only in the model engineer's workshop that there is scope for using the lathe as a milling machine; the instrument maker and horologist find it equally useful in this capacity, as may be proved by the fact that all well-known makers of instrument and watch lathes have listed a range of attachments for milling in the lathe; and these, so far from becoming obsolete in modern practice, tend, if anything, to become more popular and varied.

Although equipment of this nature is less frequently provided for larger lathes, it is none the less applicable, and can often be used with advantage in the repair shop or garage—unless the latter establishment is concerned merely with routine overhauling and the fitting of ready-made "spare parts."

Pros and Cons

It should not be necessary to defend or justify the practice of milling in the lathe; though there is a good deal of controversy as to whether it is practical or worth while, there are few experienced operators who will question this point. One sometimes hears it said "The lathe is too limited in its movements for use as a milling machine," or "Small lathes are not rigid enough"; other critics will compromise by saying "All right for a little fiddling job, but no use at all for production work." These objections must be taken into account in considering just what one may expect to be able to accomplish; it is only by recognising the limitations of any tool or process that one can hope to use it to advantage.

Let it first be clearly understood that there is no question of a lathe competing on equal terms, in respect of either range or efficiency, with a well-designed milling machine for this class of work; its main claim to consideration is its ability to fulfil, more or less efficiently, the duties of a milling machine when one is not available. But this does not mean to say that it should be regarded as simply a makeshift.

Much useful milling work can be done on the lathe, by the use of its normal movements and adjustments, but when, as often happens, these impose inconvenient limitations, they can be supplemented by the addition of attachments, such as a vertical slide or indexing head, which increase its scope. It is, however, important to note that the fitting of elaborate attachments to a lathe may not only make it cumbersome to manipulate, but also tend to increase troubles due to lack of rigidity, which is, perhaps, the most serious practical limitation, at least in the case of small lathes, when adapted to milling. The simplest rig which provides

the required range of movements will generally be found to be the most efficient.

With regard to the ability of the lathe to tackle production milling, the question arises: What is production milling? If one takes it to mean the removal of large quantities of metal, as in slab milling and similar processes, the lathe is obviously unsuited to this work; but there are many operations which are quite legitimately within the category of production work—such as screw slotting, tap and reamer fluting, keyway cutting, and so on, which can be carried out just as quickly on a lathe as on a milling machine; indeed, in some cases, time can be saved by avoiding the need for re-setting work. We have heard a good deal in recent years about the hold-ups caused by "bottle-necks" in production work, and in the writer's experience, these have often been caused by the lack of sufficient milling machines to handle quite small operations, which have often proved to be capable of being carried out in simple lathes which were standing idle. The greatest difficulty in such cases has been to get production engineers to realise these possibilities, as many of them have simply never heard of using a machine for anything outside its specific job.

A writer in *Machinery*, some weeks ago, in describing a fixture for carrying out a tricky production milling operation, stated "the fixture was designed to fit on a lathe, as no milling machines were available at the time." It is therefore clear that milling in the lathe is by no means beneath the notice of production engineers.

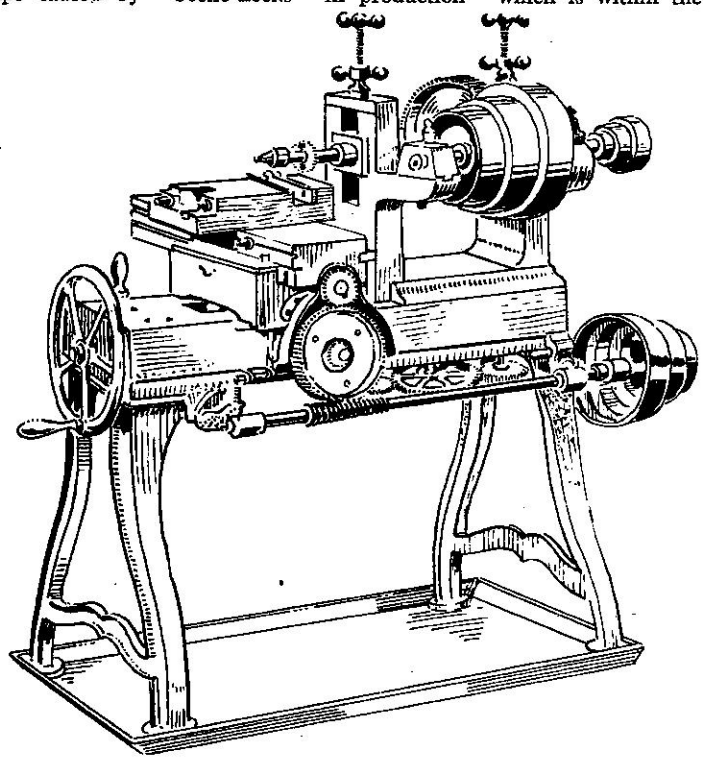


Fig. 1. An early "Lincoln" type milling machine, the design of which shows many traces of its evolution from the lathe

Evolution of Milling Processes

It will help us to a clear understanding of principles and processes if we first have a clear idea of what is meant by milling, and then go on to review the progress of its application to engineering practice. Milling may be said to define almost any kind of a machine tool operation in which rotary cutters are employed. It will be seen that there is a good deal of overlapping in the functions of different types of machine tools, as, for instance, in rotary boring, which is within the legitimate scope of either the lathe or the milling machine, and in drilling, which can be done either in the lathe, milling machine, or drilling machine. Keyway cutting with end mills—essentially a milling operation—is often referred to as "slot drilling," while high-speed operations on soft metals are classed as "routing."

In most milling operations, the cutter is traversed in more than one direction, and in this respect is not subject to the limitations of the plain drill or boring cutter, which can only travel axially. "End milling" is characterised by the use of a cutter which cuts entirely, or principally, on its end face, while "side milling" uses the periphery of the cutter. The special features and uses of various forms of cutters will be discussed later.

It is quite possible that milling processes were first evolved in conjunction with lathe work, and Holtzapffel and other early writers on machine tools show many applications of rotary cutters on the lathe.

The horologists were probably the first to evolve a machine specifically intended for milling, to cope with the necessity for some means of cutting the teeth of clock gears quickly and accurately. Cutters having a large number of fine teeth were employed at first, and this type of cutter still persists for some classes of work.

In the first milling machines employed in engineering practice, the relationship to the lathe is at once recognisable. The "Lincoln" type milling machine, introduced about 100 years ago, consisted of a lathe bed on which was

mounted a more or less normal type of slide-rest, and a headstock, also somewhat similar to that of a lathe, except that it was provided with means of raising or lowering the mandrel. This general form of machine, improved in detail, is still used for certain purposes, but the "knee and column" type of machine, which gives a far greater latitude of vertical adjustment, is by far the more popular, and is made in a wide variety of types for horizontal, vertical and adjustable-angle milling.

A consideration of the various types of modern milling machines, and the methods by which they are applied, is by no means beside the point in a treatise on lathe milling processes, as it helps one to understand the underlying principles of these processes and gives one ideas on how to use them to best advantages. THE MODEL ENGINEER Handbook, "Modern Milling Practice," can be recommended as a simple but comprehensive text-book on this subject.

Classification of Milling Processes

It has already been mentioned that the lathe cannot be recommended for carrying out heavy milling operations which involve the removal of large masses of material at a high rate of output. Beyond this, however, nearly all known milling operations can be carried out in the lathe, even including the more complicated operations, such as gear cutting, spiral milling, profiling, and form generating, which are often considered to be the exclusive province of the elaborate universal milling machine. The scope of milling in the lathe, so far as variety of work is concerned, is limited only by the ingenuity of the operator and the pains which he is prepared to take in fitting up fixtures and attachments, and in setting up the work.

In reviewing processes and appliances, typical examples of each, taken not only from the writer's personal experience, but also that of other contributors to THE MODEL ENGINEER, (to whom due acknowledgment will be made), the main object being to demonstrate, by concrete examples, the methods of tackling various problems which arise in normal model engineering practice. Of the innumerable types of milling appliances which have been described in THE MODEL ENGINEER, at various times, only representative examples, or those embodying specially interesting features of design, will be illustrated. Reference will also be made to proprietary milling appliances which have been produced by makers of lathes or their accessories.

It is proposed to classify the various aspects of milling in the lathe under the following headings: (1) Milling Cutters; (2) Milling Without Special Appliances; (3) Use of the Vertical Slide; (4) Rotary-spindle Milling Attachments; (5) Means of Driving Cutter Spindles; (6) Indexing Gear; and (7) Application of Lathe Milling Processes to Model Engineering.

(*To be continued*)

H.M.S. "Portland"

(*Continued from page* 54)

planking was put in because I thought it set off the black of the main wales and looked better than the brown of the frames; but it is not usual in dockyard models to put any planking below the lowest main wale unless the whole bottom is planked. That this method of building is accurate is proved by the fact that the original prick marks were visible at the edges of the frames in the finished model, equal to an error of $\frac{1}{4}$ in. in the original ship, given that she was dead accurate to the drafts, which, being a wooden ship, she would not be.

Perhaps it would be better to say equal to an error of not more than 1/64 in. from the drafts, which were to the same scale as the model. It must be repeated that too much care cannot be taken to get each frame fastened in accurately all ways, as the whole shape of the ship depends on this; any inaccuracy in one frame will throw out all frames aft of it and there is no cure short of starting all over again. If one of the frames, on either side, is "oot 'o ploomb," then all work put in subsequently, however good, is time wasted. But it is not difficult, or I could not have done it; it is merely a question of taking time and care.

The cutting of the frames or sections has been described as being cut at the floor and futtock lines; this is not strictly correct, but is so described for simplicity. Actually, in the ship each frame is in two pieces bolted together with the futtocks overlapping; but, as has also been pointed out, dockyard models are not built like the ship as far as their frames are concerned.

When all was in place, a rabbet was cut along the top of the frames halfway through the thickness and the whole stained a golden brown with a stain procured from Messrs. Dryad Handicrafts. These stains are described as being for leather; they are sold in a wide variety of colours which can be mixed; they are in crystal form and are soluble in alcohol; consequently, they do not bring up the grain of the wood like a water stain would, an important consideration. Leather stains or not, they certainly seem to be the best stains for wood.

The wood was then varnished with a shellac "pad" polish; I think the trade term is "garnet." When dry, this was smoothed down by stroking, *not* rubbing, with steel wool. This process was repeated until the pores of the wood were filled inboard and out, but with no visible thickness of polish on the surface. Later, all beams, knees, pillars, etc., were also stained and polished after fitting, but before fixing into the ship; one cannot get at them to do it after. The deck planks were polished but not stained. Steel wool breaks up into tiny pieces when used; to get these out of the inside of the hull use a magnet. The upper frames were then cut out, which provided the sides of the ports in the same manner as the lower frames, with additional frames where the spaces appeared too wide.

(*To be continued*)

A REFLECTING TELESCOPE SPECULUM

By L. C. W. HOLT

ANY model engineers who have included observational astronomy amongst their hobbies, may be interested in a method of constructing an efficient astronomical telescope for only a fraction of the cost of a similar instrument if bought second-hand.

The simplest, and also the most convenient to use, and mount, is the "Newtonian" reflector telescope, the type invented and first made by Sir Isaac Newton.

The reflecting telescope, unlike the more familiar refractor, does not have an object-glass at the front-end of the tube, instead it has a concave mirror called the "speculum" mounted at the other end.

Beyond the Power?

A refractor telescope would be beyond the power of the average amateur to make, as the most important part, the objective, consists of two lenses called the crown lens and the flint lens; they are made of special glass, and both sides of each must be very accurately ground and polished; on the other hand, the speculum of the reflector can easily be made by hand with no special tools; it is chiefly the making of this speculum that will be considered here.

From the point of view of the amateur astronomer, the Newtonian reflecting telescope has almost every advantage over the refractor. It is perfectly achromatic, the refractor is not.

The observer can look horizontally into the eye-piece at whatever position the telescope is in, even if the telescope is pointed towards the zenith.

A reflector of the same effective size is only half the length of the refractor, a refractor of 6-in. aperture would have to be a permanent fixture in an observatory, a reflector of 6 in. can easily be carried in and out of the house, or even used at an open window, if necessary.

If the user of the telescope decides to try his hand at telescopic photography, then also the reflector has the advantage, as the light which affects the photographic plate comes to a focus at exactly the same distance from the speculum as the light which affects the eye, or the visual and photographic light is reflected at the same angle, but is not refracted at the same angle, the actinic rays are refracted at a greater angle than the visual rays.

A Newtonian reflector of any size up to 8 in. can easily be made by the amateur, a 6 in. is considered here, any size might have been chosen, 3 in., 4 in., anything up to 8 in., anything larger would be rather difficult; in constructing a telescope of this kind there is only one part which is likely to give any trouble, and that is the large mirror or speculum, the rest is chiefly a matter of improvisation.

The first thing to do in making the speculum is to get a few easily obtained materials together; these are: two discs of glass, 6 in. diameter by about $\frac{3}{4}$ in. to 1 in. thick; about $\frac{1}{2}$ lb. of pitch; a few ounces of beeswax; some turpentine; carborundum powder, 3 oz. each of grades 60, 120, 150, and F; some emery powder, 3 oz.; jewellers' rouge, 3 oz.

Silvering

Also anyone attempting to do the silvering himself will require the chemicals for this. The silvering is not a difficult job, but as it can be done by any glass merchants quite cheaply, it may not be worth the trouble of doing it oneself.

The actual making of the speculum is the next job, and is done as follows.

The two discs of glass are rubbed together, face to face, with some No. 60 carborundum and water between them, until both are completely frosted on one side.

The least perfect of the two discs of glass is then cemented on to the corner of a bench, or any other suitable support of convenient height, with a mixture of approximately 80 per cent. pitch, 10 per cent. beeswax, and 10 per cent. turpentine; numbers 1 to 8 are then chalked on the bench round this glass disc every 45 degrees, in a clockwise direction (Fig. 1); this

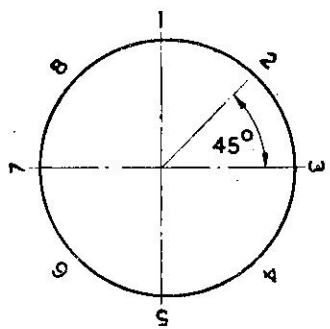


Fig. 1

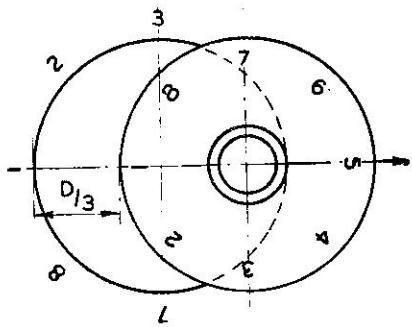


Fig. 2

piece of glass is the tool on which the speculum is to be ground. A small handle is then cemented on to the centre of the roughened face of the other glass, this will eventually be the speculum, the numbers 1 to 8 are then chalked on the back of this glass every 45 degrees, but in a counter-clockwise direction; the object of the frosting is to enable the tool to be firmly cemented on to the bench, the handle to be cemented on to the other glass, and also so that the figures can be chalked upon it.

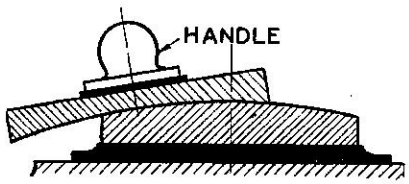


Fig. 3. *Speculum and tool in section*

The actual grinding can now be started. Some No. 60 carborundum and water is spread over the tool, then the other glass disc is held by the handle, and rubbed over the tool two or three strokes. Centre over centre overlapping 1/3 of the diameter of the glass disc, in this case, 2 in., the diameter 1-5 is rubbed over on both glasses (Fig. 2), the same number of strokes are repeated over the diameters 2-6, this changes the line of rub 45 degrees on each glass, next diameters 3-7, and so on, the same number of strokes, say, two or three each time.

The top glass will gradually become concave (Fig. 3) and the tool convex.

Testing the Curvature

The test for curvature is made as follows: supposing a focal length of 5 ft. is required, water is poured over the concave surface of the speculum, which is propped up on its edge, a lighted candle is held level with the eye, and the worker walks backwards from the mirror, watching the reflection of the candle flame in the wet surface; at the point between where the flame reflection appears right way up, and where it appears inverted, is the radius of curvature at this stage, which is always double the focal length; at this stage it should be about 12 ft., or a focal length of about 6 ft.

The final focal length of the speculum need be no exact length, any variation in length only very slightly alters the magnifying power of the telescope, for any given eye-piece the power depends on the focal length of the speculum. Conversely, for any given focal length of speculum, the power is inversely proportional to the focal length of the eye-piece used; several interchangeable eye-pieces are generally used for my telescope, according to the power required for any particular object viewed.

Supposing the first stage of grinding with the No. 60 grade carborundum has resulted in a curve of 12-ft. radius, or a focal length of 6 ft., the subsequent grindings and polishing will reduce the focus until it reaches about 5 ft. focus when completed.

The next stage is the elimination of all scratches made by the No. 60 grade carborundum, by grinding in the same way with No. 120, then No. 150, then grade F, and finally with emery. The important thing is that after every abrasive has done its work in removing all traces of the previous grinding, everything must be washed and the bench brushed, for supposing the grinding was being done with grade 120, and a single grain of grade 60 were to remain on the tool, it would cut scratches in the surface of the speculum, which it was the purpose of grade 120 to remove.

After the grinding with the emery, the focal length of the speculum will have shortened, possibly to 63 in., every scratch made by the finest grade of carborundum should have been removed; at this point the curve of the face of the speculum will be spherical.

Polishing

The next stage is the polishing, and it is during this process that the curve is changed from spherical to parabolic.

The first thing to be done is to rub the surface of the tool with turpentine, then pour over it some melted pitch mixture, the concave surface of the speculum is then warmed and wetted with soapy water, and is allowed to rest on the surface of the pitch for half-an-hour, weighted down with a 2-lb. weight. The pitch on the tool will then conform to the curve of the speculum, the surface of the pitch is then crossed and recrossed, making a pattern of $\frac{3}{4}$-in. squares with "V"-shaped grooves of approximately 3/32 in. deep by the same width; these cuts can be made best by a razor blade; their object is to prevent the speculum from binding by suction during the polishing process (Fig. 4). The only difference between the polishing and

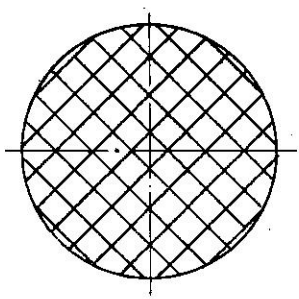


Fig. 4

the grinding, is, firstly, that only the finest grade of jewellers' rouge is used instead of the carborundum and emery, this is rubbed over the pitch in the form of a paste made of the rouge and water; secondly, when the speculum is passed over the tool, the centre of the speculum does not pass over the centre of the tool, but at their nearest points the centres are $\frac{1}{2}$ in. to $\frac{3}{4}$ in. apart, this action changes the spherical curve into the parabolic (Fig. 5).

When the polishing is completed, the speculum should be tested in this way: an annulus of

cardboard, 6 in. outside by 2 in. inside diameter, is placed over the face of the speculum, and a reflected image of a candle flame is thrown on to a post-card, the image must be perfectly clear, then the annulus is removed and a disc of 2 in. diameter is placed over the centre of the speculum, if the curve is a perfect parabola the image

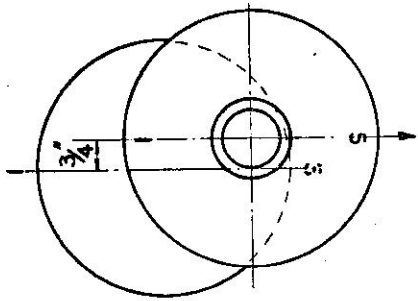


Fig. 5

should be still just as clear, the positions of the card and speculum must have remained the same. Should the image formed by the centre of the mirror be found to be farther from the speculum than that from the outside, then the polishing will have to be continued for another twenty minutes, the centres passing at their nearest point about 1 in. apart, but if the reverse is found, on trial, then the polishing must be continued for the same extra time, but with centre over centre strokes.

When correct, the speculum may be silvered, or if the rest of the telescope is ready, it can be first tried by observing a star; in focus this should appear a sharp pin-point of light.

The silvering can be either done at home, being quite a simple process, or can be done by a maker of household mirrors, but the important thing is that the silver film must be on the concave face, and must not have any sort of lacquer over it, it will last for years if not touched; as it is in the back end of the telescope there is no need for this to happen.

The next thing which requires explanation here is the diagonal reflector; this reflects the light from the speculum at right-angles to the axis of the tube into the eye-piece adaptor; this can be made from a piece of ordinary plate-glass mirror, by washing off the protecting red paint and polishing with a piece of very soft wash-leather and some jewellers' rouge.

There are several methods of mounting the diagonal reflector, but it must be adjustable. A satisfactory method is that illustrated below (Fig. 6). A 45-degrees to 90-degrees prism, if large enough to collect all the light reflected from the speculum, is very satisfactory.

Eye-pieces

Eye-pieces are fairly cheap and easily obtained, and are hardly worth the trouble of making. Eye-pieces from microscopes can be used, it is useful to have at least three eye-pieces, giving powers of approximately 50, 100, and 200 diameters for this type of telescope; the focal length of the eye-piece required is found by dividing the focal length of the speculum by the power, for example, if the focal length of the speculum is 5 ft., or 60 in., and the power required is 120 diameters, then an eye-piece of ½-in. focus will have to be used.

The telescope may be mounted in several ways, but however it is done, one thing is a great advantage, that is that one axis on which the telescope turns should be parallel with that of the earth, so that one movement will follow a celestial object; this, with some form of slow motion, is essential if any photography is attempted.

The most satisfactory mounting of all is that form called the equatorial; by this is generally meant a mounting on which the telescope moves on two axes—one parallel to the axis of the earth on which is mounted the hour circles, and one axis at 90 degrees to this, called the elevation axis, on which circles marked in degrees, mark the elevation above or depression below the celestial equator.

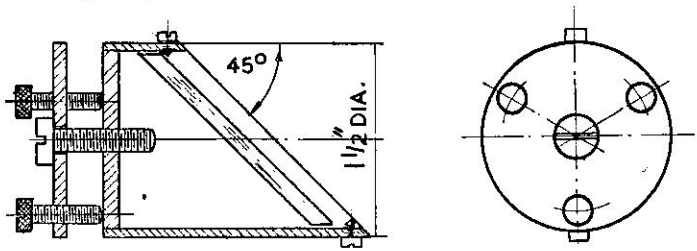
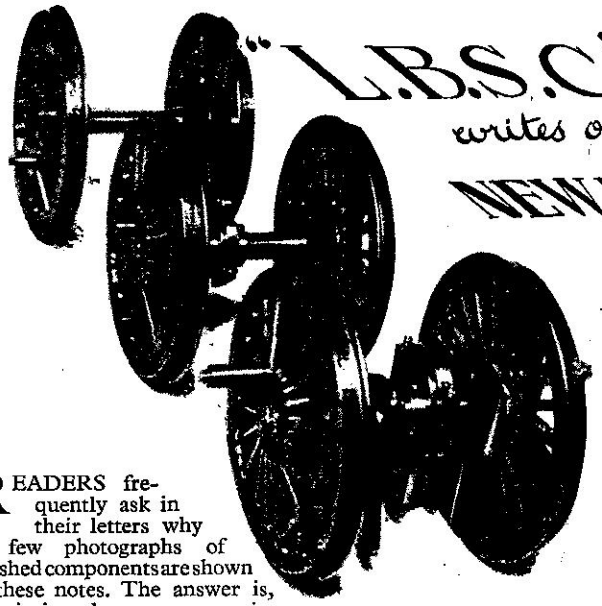


Fig. 6. Section and end view, showing method of mounting the diagonal reflector

The most satisfactory tube for a telescope of this kind is simply a long, square section, wooden box, as all fittings are easily screwed into this with ordinary wood screws. Wood is also better than metal, as it is a better insulating material, and variations in the optical density of the air in the tube, caused by sudden changes in temperature, are not so liable to occur.

In a short description of this kind, it is impossible to go into the subject of the actual details of construction of either the telescope or the mounting; but may serve to show that a very efficient astronomical telescope can be made by anyone, with the simplest of tools.

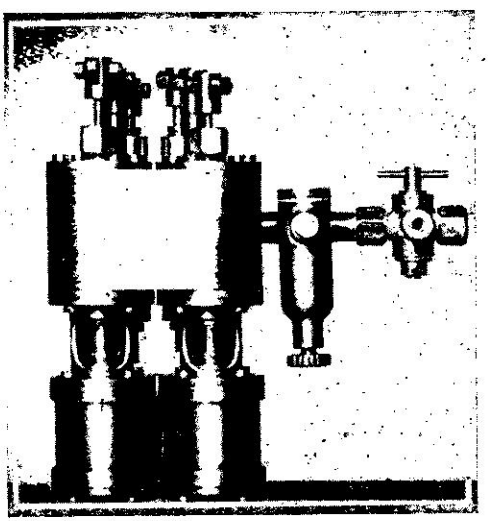


"L.B.S.C." writes on a NEW ENGINE for the LOVISELUND LINE.

READERS frequently ask in their letters why so few photographs of finished components are shown in these notes. The answer is, that it is only on rare occasions that I get any suitable for reproduction. One of those rare occasions has just come around, and I hope the querists will be pleased with what they see here. Pre-war followers of these notes won't need any introduction to Mr. Arvid Ohlin, the Stockholm textile manufacturer who does a bit of locomotive building in his limited spare time. His last completed engine was a Swedish version of "Princess Marina," and a very fine job it was too, earning great praise from the "heads" of the Swedish railways who saw it in steam on Mr. Ohlin's own road. Our worthy friend visited England occasionally before the war, and came to see me on two or three occasions, the last being eight years or so ago; and knowing our hacienda to be in what was a very "vulnerable area," he was greatly concerned for my safety when Jerry started his antics. Mr. Ohlin managed to get two letters and a cablegram through to me during hostilities, and I sent him a repaired injector, but I think Davy Jones carried out some experiments with that, to see if it would work with sea-water, as it never got to Stockholm. Or maybe the ober-sub-rear-admiral (or whatever he is called) of a tin shark captured it and sent it along to Fatty Hermann for his Jerry Pacific; if so, I hope it caused his crown sheet to collapse.

Anyway, in the cablegram, which managed to reach me *via* Denmark, Mr. Ohlin said he was starting on a 3½-in. gauge Continental Pacific. The rest was silence until the era of bloodshed and destruction was finally over, when a welcome letter arrived from Mr. Ohlin saying that he was now receiving copies of this journal regularly again, was glad to note "L.B.S.C." was still writing as usual, and the Continental Pacific was making good progress, adding that he would send some photographs of the components before assembly. This promise was duly kept, one of his relations, who lives in Surrey, bringing them over personally, and you can see for yourselves that our worthy friend can make other things beside textile goods. I have no particulars of the engine as yet, except that she is built generally to Continental dimensions for 3½-in. gauge, and that the principles expounded in these notes have been faithfully adhered to; but some more pictures and a description have been promised, so we'll look forward to seeing something really good from Stockholm.

Incidentally, I wonder what has become of the other "brothers of the craft" who used to write to me from Sweden—Mr. Heribert Nilsen, of Malmo, Mr. M. Hede, of Stockholm, and two or three others whose names I cannot recall for the moment? I would be glad to hear if they

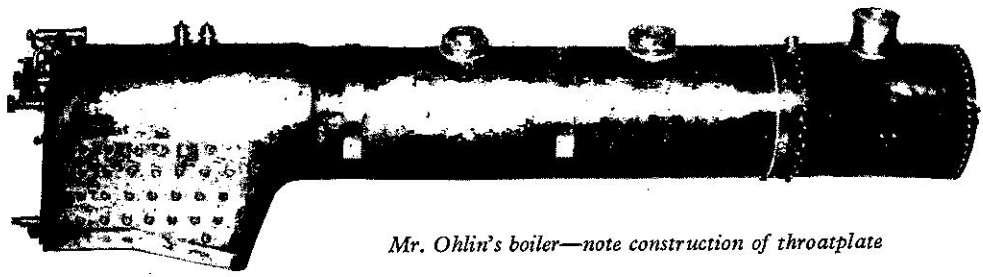


Duplex donkey-pump

are still in the land of the living, and as our cousins over the big pond would say, "to know what's cooking."

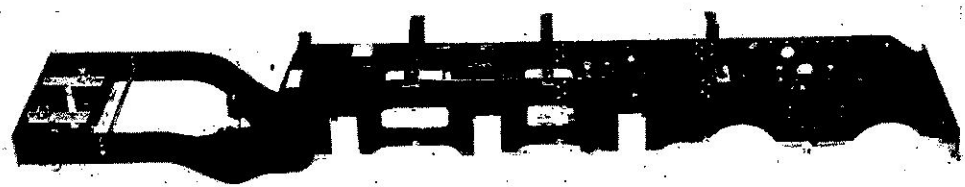
Too Much Heat in One Place

As I pointed out in a recent note, you can always have too much of a good thing; and another example of the truth of this saying has recently come to hand. A reader who was building a boiler for "Petrolea" obtained the use of an oxy-acetylene blowpipe and thought he was in clover for the job of brazing up the boiler; but having had little or no experience in brazing and Sifbronzing, decided to use silver-solder, as he thought that would run easier, and be certain to make perfect joints. To his great dismay, instead of flowing nicely into the joints, the molten silver-solder just bubbled up, and the resulting joints were spongy and full of pinholes. He wants to know the reason for this behaviour, saying I always advocate plenty of heat as one of the necessities for successful boiler brazing, and he certainly had plenty.



Mr. Ohlin's boiler—note construction of throatplate

The solution is simple; he just had too much heat in one place. The direct flame of an oxy-acetylene blowpipe is too concentrated for silver-solder, which melts and runs at a low temperature; dull red for the finer grades. In the intense concentrated heat of our friend's blowpipe, the silver-solder just fused and boiled up, so to speak, before the copper had a chance to reach the temperature required for proper amalgamation. He should have heated the copper before applying the silver-solder. Amateur and inexperienced workers who have had little or no instruction in the use of an oxy-acetylene blowpipe, would do far better if they used an ordinary blowlamp, or an air-gas blowpipe, for silver-soldering, as it gives a large diffused flame; also they should very carefully follow the instructions I give for brazing and silver-soldering boiler joints. The metal of the job itself should always be heated up to the melting-point of the jointing metal before same is applied. The only exception to this rule is in the case of fixing a set of tubes into a firebox tube-plate; the silver-solder can be applied in small squares between the tubes, or a ring of silver-solder wire can be placed around each, close to the tube-plate. In both cases, the tube-plate is first of all heated by blowing the flame into the firebox, and it therefore doesn't impinge directly on the silver-solder. When the tube-plate glows dull red, a slight application of the blowlamp flame to the outside of the tubes is sufficient to start the silver-solder running; and as the tube-plate is hot enough for amalgamation to take place, perfect joints are the result. The silver-solder has no time to "boil and bubble," but sinks into the joint and forms a smooth even fillet all around the tube. I still have my original three blowlamps—one, two-and-a-half, and five-pint sizes—and occasionally use the middle one to put in a nest of tubes at one fell swoop, by way of variety. Sometimes I use an oxy-coal-gas blowpipe for the same purpose, when the tube-plate is of extra thickness. This gives a big diffused flame of a pale violet colour, a little hotter than the blowlamp flame when going all out—which sounds rather like Tommy Handley's Welshman—a blow-lamp being all alight and all out at one and the same time, but you know what I mean!

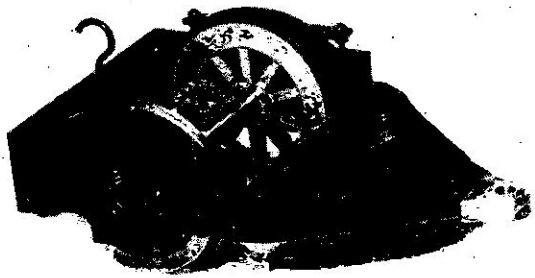


Frames erected

Temperature Varies with Material Used

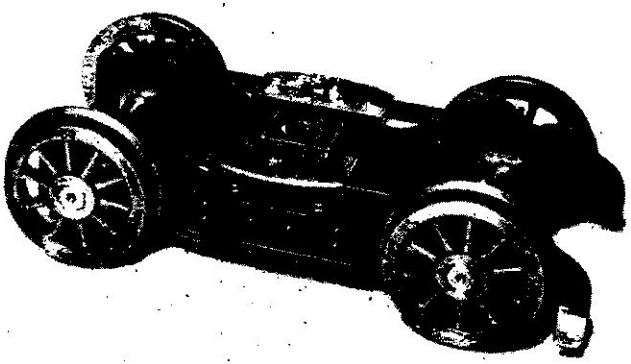
There is no doubt, in my own experience, that the best jointing material to use, when building up copper boilers with an oxy-acetylene

blowpipe, is Sifbronze; and for new readers' benefit I will repeat the method of applying it. Apply the special flux to the joint, mixed to a paste with water; using a tip a little bigger than the blowpipe-makers recommend, with a little less than normal pressure, heat the metal of the joint to bright red, and then apply the Sifbronze rod in the flame close to the joint, so that a teardrop melts off and plops right on to it. This will immediately spread and penetrate. Shift the blowpipe flame ever so slightly, and plant the next teardrop so that it slightly overlaps the first; ditto repeato the whole way along. When doing a foundation ring, for example, have the boiler upside down in your brazing pan, with the barrel to your left. Start operations at the corner of the foundation ring nearest to you at the backhead end, and work towards the throatplate, so that the end of the flame is always ahead of where you are dropping the spots of Sifbronze, and is kind of pre-heating the work in advance of the actual operation. The result is a rippled surface, perfectly sound joint, and no pinholes.



Pony truck

Easy-running brazing-strip acts differently from Sifbronze. It contains a lot of zinc; and if you use the same temperature flame, with the same "technique," the zinc content will burn up before the molten metal has time to penetrate the joint. The result will be a porous seam, the holes being easily visible. Either use a big blowpipe tip and low gas pressure, to get a diffused flame of lower temperature than used for Sifbronzing, or better still, use an oxy-coal-gas blowpipe. Some brands of easy-running brazing-strip, such as "Lafitte," are far more easily worked with a blowlamp or an air-gas blowpipe; in fact, the brand mentioned can be used to make perfect joints in brass, by anyone who has the knack of knowing just how much heat to apply to prevent melting the brass itself, which has a melting-point very little higher. You can always tell at once if you have too much heat when using ordinary easy-running strip, as the zinc will burn out with a blue flame and clouds of white smoke. Mind you, there are tricks in every trade; and experience and common-sense combined can work wonders. If, for instance, an expert blowpipe artist wanted to use his pet "putting-on tool" with easy-running strip, he would flux the joint with a paste made of Boron compo and water, heat it as for Sifbronze, and apply the strip so that it did not get the full force of the flame. This would give the strip a chance to melt and flow before the zinc had time to burn out. Our friend might have worked a similar wheeze with the joints of his "Petrolea" boiler; if he had heated the joints to bright red, and then switched the flame momentarily aside as he applied the silver-solder, the heat of the joint itself would have melted it and allowed it to penetrate without bubbling. You can even soft-solder with an oxy-acetylene blowpipe if you are quick enough; I have done it many a time. For example, I stopped up a few leaky stayheads for one of my few personal friends; the metal was scraped clean, a drop of Baker's fluid applied, and as the copper plate of the boiler was only 16-gauge, a small bead of solder was placed alongside. The pressure at the blowpipe tip was adjusted so that the flame was perfectly silent, with no hiss whatever; the end of the flame was applied to the stayhead, and in less time than it takes to write these words, the bead of solder melted and "flashed" around the head, making a perfect seal.

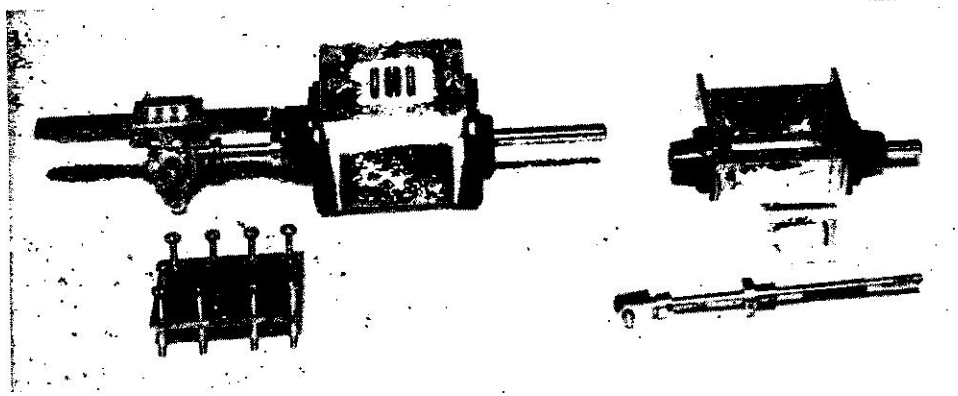


Leading bogie

Get This Right—

When I say in my boiler-brazing instructions, "the secret of success is heat and plenty of it,"

or words to that effect, I mean *plenty of heat at the right temperature.* The actual joint must be at the melting temperature of the brazing-strip, silver-solder, or whatever is being used; and as copper is one of the best metals for conducting heat (one reason why we use it for little boilers, apart from its non-rusting properties), you must apply enough heat to make up for what is being conducted away from the joint, or else have a diffused flame big enough to envelop, not only the joint, but the surrounding metal, so as to keep the actual joint at the proper temperature. Beginners can now appreciate the reason for packing all around a boiler-brazing job with coke or breeze. This becomes red-hot under the blowlamp flame, and keeps the whole boiler at a temperature which prevents undue cooling by conduction, convection, or whatever the Oxford or any other dictionary likes to call it, of the actual joint being brazed or silver-soldered.



Cylinder for Mr. A. Ohlin's 4-6-2

That is what is meant by plenty of heat, as applied to boilersmithing. The blowlamp flame must, of course, be big enough to pump the "therms" in faster than the copper can dissipate them.

Another Apparent Anomaly

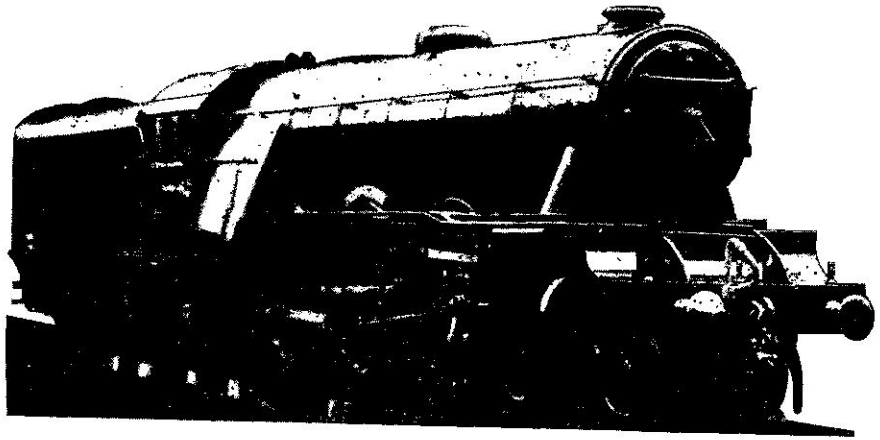
Beginners sometimes write and ask, how is it that a flame which will easily melt a steel plate or bar, can be used for making joints in a small copper boiler? They imagine that it would be completely melted up in next-to-no-time. The answer is found in the preceding paragraph; it is the heat conductivity of the copper that prevents disaster. A good commercial use is made of this fact. When oxy-acetylene blowpipes were first put on the market, a gentleman named William Sykes, Esq., who, like company promoters, tinhorn gamblers, three-card-trick experts and so forth, like to acquire cash without the trouble of earning it, thought it would be a swell idea to take along a portable set to the local branch of Fireclay's Bank, open the safe, and help himself to the contents without the trouble of making out a cheque. But the good folk who made the safe had "got there first," in a manner of speaking; for blow as he might, William could make no impression on the safe. The metal just refused to melt. Unofficial history doesn't say whether William took the blowpipe back to the makers and kicked up a shindy about its being useless, or whether the local Sherlock Holmes got busy and tracked him to his lair by following the niff of acetylene; but what actually stopped his gallop was the fact that the wily birds who made the safe had done a bit of thought-reading, and anticipated William's antics by making it of three-ply metal sheeting—two plates of steel with a copper one between—so that the copper conducted all the heat away and rendered the action of the blowpipe null and void.

Down at the Swindon locomotive factory, they cut out main frames from 1¼-in. steel plate with an oxygen cutter carried on an adjustable frame. Your humble servant—imitation being the sincerest form of flattery!—occasionally cuts frames from ⅛-in. steel plate by exactly the same process, except that my little "Lilliput" cutter doesn't need any frame to carry it, and runs on a couple of little wheels over the surface of the plate being cut to shape. But neither Swindon nor Curly could cut out copper firebox plates by the same process, for reasons mentioned above; so we both use a saw. Great minds again!!

Its Last Home!

I wonder if there has ever before been a case of a full-sized railway signal retiring after many years' service at a busy main-line station, and finishing its days alongside a little line, solemnly doing its accustomed job in the manner usually observed among the fraternity of the signal world? Some time ago, when the Southern Railway recommenced their signal renewal programme, replacing the old semaphores with colour-lights, or new signals of what the kiddies call the "up-for-down kind," I asked them if they would let me have one of the old Brighton signals to stick up alongside my little road, as a keepsake and a reminder of happy days long past. Soon after, the ganger in charge of the local renewal work called and asked if No. 12 shunt

(*Continued on page* 69)



A "LONE HAND'S" WORK

by S. Baker

I WAS a "Lone Hand" until a few years ago, when I wrote to "L.B.S.C.," and it is the encouragement I received from him and my good friends, Messrs. Tucker, of Bramhall, that has prompted me to publish some description of my work.

The photographs give a good idea of my latest engine, a L.N.E.R. Pacific, to 17/32-in. scale and 2½-in. gauge. The nucleus of this engine was a set of wheel castings obtained through the "Small Advertisements" in THE MODEL ENGINEER." The wheels and the cylinders are the only castings used. I obtained a photostat copy of the general arrangement drawings of the full-size engine and made a start.

The frames are mild-steel plate, double at rear, and fitted with radial trailing axleboxes, as in the prototype; the bogie is independently sprung and holds the road well at high speed. The cylinders (two) are ⅞-in. bore by 1¼-in. stroke, the type specified for "Austere Ada." To use the long stroke with scale crank-bosses, I fitted eccentric main crank-pins; this idea works well in practice and cannot be seen when erected. The motion and lubricator are also "Ada" modified.

The boiler is exactly to scale dimensions and is fitted with combustion-chamber and seven ⅝-in. tubes, and one ¾-in. flue; the grate is 3¼-in. square, the centre portion being hinged to drop into ashpan. It steams very well and supplies all the steam necessary, and some to spare.

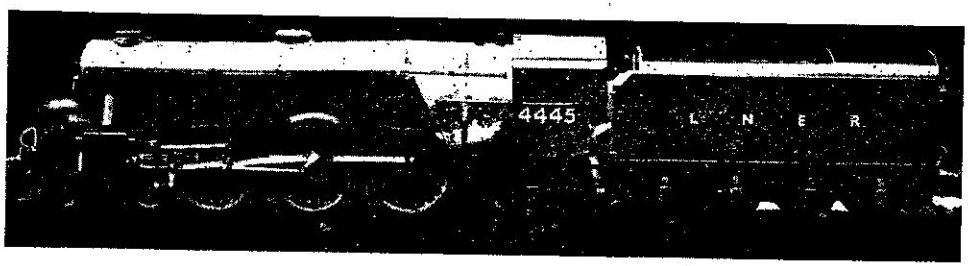
It was built entirely from scrap copper; the barrel is a piece of hot-water pipe, the firebox sheets were originally old potters' printers'-plates, and I believe this is the only locomotive in existence with a willow-pattern in the firebox!

The working pressure is 80 lb., and the feed is by an axle-driven pump.

The tender is carried on working laminated springs, made in the usual way, from corset-ribs. The engine took eighteen months to build and is a great success; it will haul four passengers with ease, including myself—fifteen stones!

The photographs were taken by Mr. A. Sandbach.

I am at present well advanced with a 3½-in. gauge 0-6-0 industrial tank engine, which I will, with the Editor's permission, describe at a later date.



CINÉ DESIGN

RONALD MOSS COMMENTS ON TWO INTERESTING SPROCKET INTERMITTENT MOTIONS FOR SUB-STANDARD CINÉ WORK

READERS who were interested in my letter published in THE MODEL ENGINEER of March 7th, will remember that I mentioned a new intermittent motion for use in conjunction with a 12-tooth film sprocket. In the same letter I criticised the use of a 12-slot Maltese-cross movement, which a correspondent stated he had used on his projector. At the time of my criticism I had some suspicion that the designer in question may have had some means of overcoming the quite justifiable objections I raised to his design. Indeed, I qualified my criticism by the use of the following cautious phrase :—"unless 'Excogitate' has neglected to mention some important point," etc.

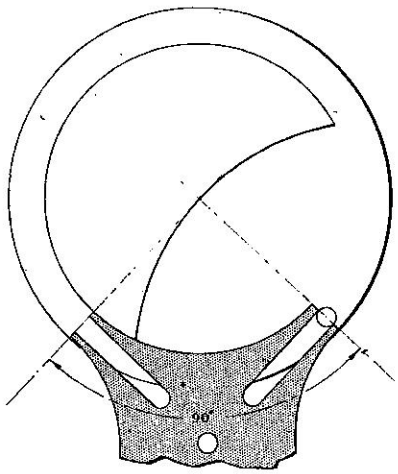
It so happened that at that time I was also interested in the making of a ciné camera. As the problem involved in the design of a camera is rather different from the difficulty experienced in projector design, I decided that there was no objection to the use of a 12-slot Maltese-cross motion for the purpose.

As the Maltese-cross motion is so ideally suited to the job in many respects, I could not help feeling that it was a great pity that any multiplication of the number of the slots results in bringing the shift period nearer to 180 degrees. If readers will glance at the illustration, Fig. 1, which illustrates the shift period of a 4-slot Maltese-cross, and a 12-slot Maltese-cross compared, they will see what I mean. It will be appreciated that a Maltese-cross gear having an infinite number of slots would have a shift period of 180 degrees. In a properly designed Maltese-cross gear the number of degrees of an arc covered by the shift period cannot be tampered with.

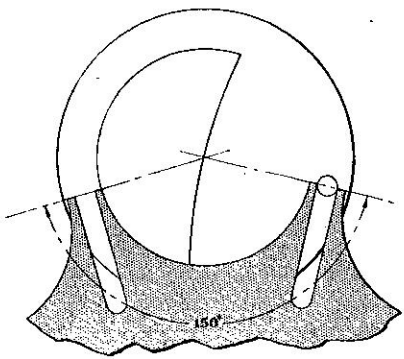
At first sight this seems to be an insuperable obstacle to the designing of a rapid-shift intermittent motion employing a Maltese-cross motion of twelve slots or more. Seeing that I relish a difficult problem, however, I decided to have a shot at finding a solution. This solution, when it was found, was so simple, and held out so many fascinating possibilities, that I shall describe it first, as it seems likely that most readers will prefer it to my other intermittent motion.

As I have said, there is no possibility of tampering in any way with the number of degrees of an arc which the driving pin travels whilst in engagement with the Maltese-cross. In the case of my Maltese-cross motion, which has twelve slots, the number of degrees was 150. This would mean that the shift period would be almost half of the frame-cycle *if the driving-pin had a uniform motion.* And in those italics you have the beginning of the inspiration because in my gear that 150 degrees is covered in one-seventh the time taken to cover the other

Figure 1.



4 Slot Maltese Cross



12 Slot Maltese Cross

210 degrees of the frame-cycle. This is done by a simple device, similar in theory to a driving-pin on a lathe engaging a carrier on a job being turned between centres.

Unlike such a job, however, the driven portion is not on the same centre as the driver, but considerably offset. This has the result of causing the critical 150 degrees engaged period of the Maltese-cross driving-pin to be accomplished in only 45 degrees movement of the actual driving member, so that for sound projection this would represent 1/212 of a second, and for silent films 1/128 of a second. Now comes one of the fascinating possibilities I hinted at. No one is likely to want a shift period one bit faster than is found to be necessary, and this device makes it possible to vary the length of the shift period by a simple adjustment. Any speed is possible, from the fastest, one-eighth of the cycle, to a speed as slow as two-thirds of the cycle. The latter speed is, of course, of no practical use, but it serves to illustrate the flexibility of the device. I refer the reader to sketches, Fig. 2 and Fig. 3, for an explanation of this linkage.

It will be seen that the Maltese-cross driving-pin and locking-disc are not fixed on the driving-shaft, but on an intermediate shaft, which carries on its other end a large catch-plate. This catch-plate has a slot milled in its surface (indicated by the letter "S" in the perspective sketch, the catch-plate being shown transparent for clarity); this slot engages with the driver-pin (letter "P" Fig. 3) on the driving-shaft. I think it will be easily understood that the *constant* rotation of the driving member will be converted to accelerated and decelerated motion on the intermediate shaft, and consequently the Maltese-cross will be engaged in its shift period at the point of highest acceleration.

In the example shown, the slot in the catch-plate and the Maltese-cross shift-pin are shown in line; should it be desired to experi-

Figure 2

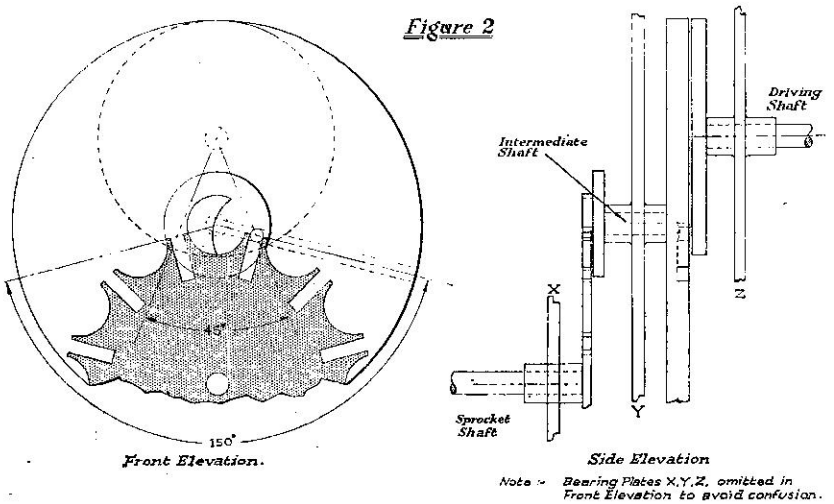
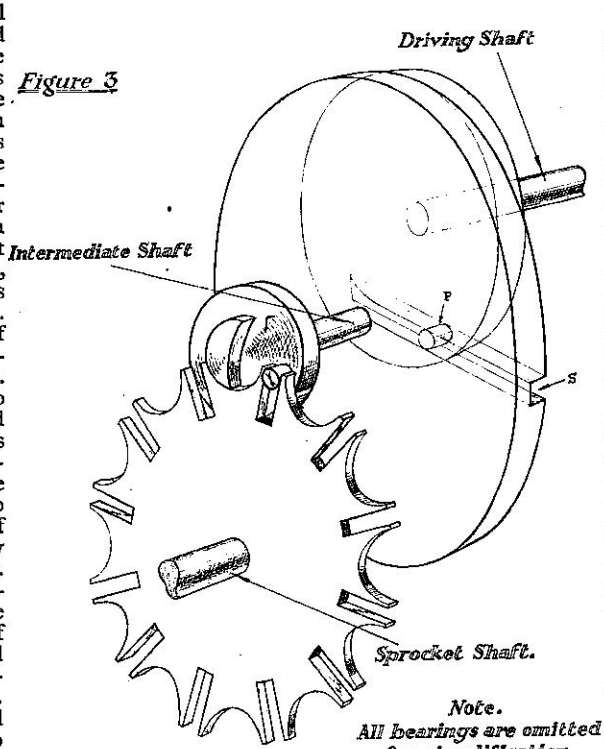


Figure 3



ment with a longer shift period, this can be accomplished by advancing the shift-pin so that it leads the catch-plate slot.

If the Maltese-cross shift-pin is given a lead of a full 180 degrees, this would give the two-thirds shift period I mentioned earlier. The maximum shift speed is, of course, one-eighth of a revolution, but this can be altered as desired, by plotting the gear according to individual requirements. Similarly, the design can be altered to suit any sprocket other than twelve teeth.

One other point which would, perhaps, be as well to mention, is that the shutter had better be driven from the driving-shaft and *not* from the intermediate shaft, as it will be found desirable to keep parts having a variable motion to a minimum. In the event of different shift speeds being experimented with, the shutter can easily be made adjustable by making it double. I think that pretty well covers the Maltese-cross gear, so I will now proceed with a description of my other gear.

This intermittent motion is composed of two main parts. A circular plate, having twelve equally-spaced pins mounted on its surface (this is referred to in diagram, Fig. 4, as shift locking-plate), and a driving member (so designated in Fig. 4) having a surface flange with cam slots cut in its surface.

In this diagram, Fig. 4, the shift-locking disc is shown as if transparent, as the pins would not be visible from the view point selected.

The motion is shown just at the start of the shift period. It will be seen that movement of the driving member in the direction of the right-hand arrow will cause the pin "B" to be drawn into the cam slot near it, being guided thereto by the latch "L"; at the same time the pin "E" will be drawn into the other cam slot. Continuation of the movement will cause the pin "B" to travel to the position occupied by pin "A," and pin "E" will now be in the position formerly occupied by pin "D." The shift locking-plate will now be held against movement by pins "B" and "C" and "E" and "F" until the commencement of the next shift period. It should be understood that the flange on the driving member is a running fit between the pins. In the diagram, Fig. 4, is shown a part referred to as a "shift starter disc," on the surface of which is the latch "L." This disc revolves with the driving member, but not on the same centre.

The reason for this is that the latch "L" must not foul anything until its point of proper engagement is reached. By causing this latch to describe an eccentric path it is swung clear of pin "D," which it would otherwise lock against. Diagram, Fig. 5, shows an "exploded" view of the driving assembly. The fixed shaft, as its name implies, is held against rotation, the driving member revolves *on* it, and the shift starter shaft runs *in* it. On the back of the shift starter disc is a small projection, indicated in the drawing as "shift starter carrier"; this is driven round by the "shift starter driving face." The fixed shaft is, of course, adjusted to bring the starter latch up against the cam face at the right point. Now as regards the actual shift period. I made the cam slots in my first drawings embrace 45 degrees, that is one-eighth of a revolution. If each cam slot is made to embrace

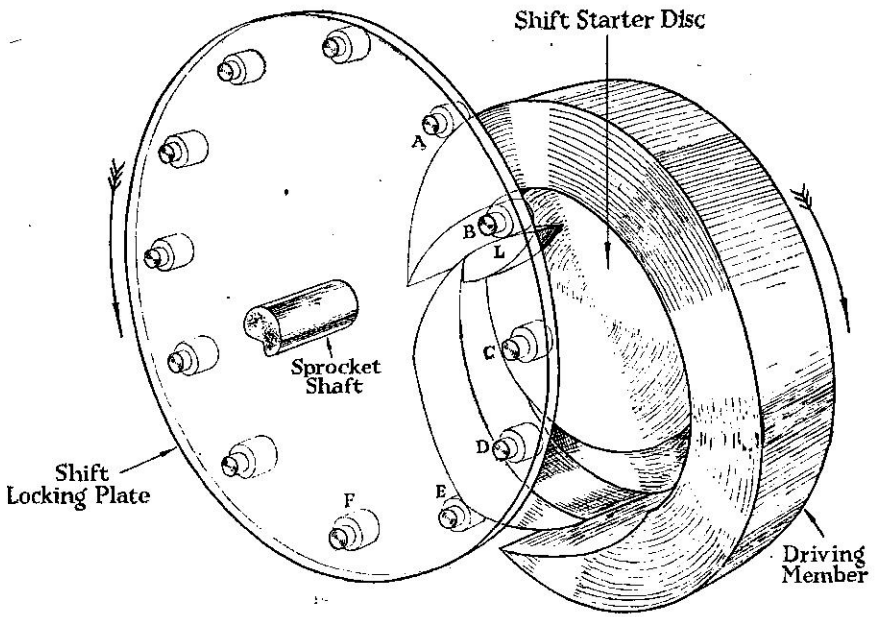


Figure 4.

60 degrees that would make a shift period of one-sixth ; this is a matter which is up to the individual designer.

In this connection it may be objected that I have given no definite data in the way of measurements or methods of securing the various parts. My reply must be that the designs, as I intend to use them, would probably be useless without some modification, both in size and other essential particulars, and seeing that the possibility of such modification exists, I would also stress the importance of using the greatest care in cutting the cam slots in the driving member of this motion. The safest way to do this is to cut the leading slot first, then assemble the parts on their correct centres with the pin "E" (Fig. 4) removed. The hole can then be used for marking out or drilling whilst the pin "B" is traversed in the other slot. Better still, a jig could be made for the job. The cam slots are shown in the drawings as being cut right through the driving member,

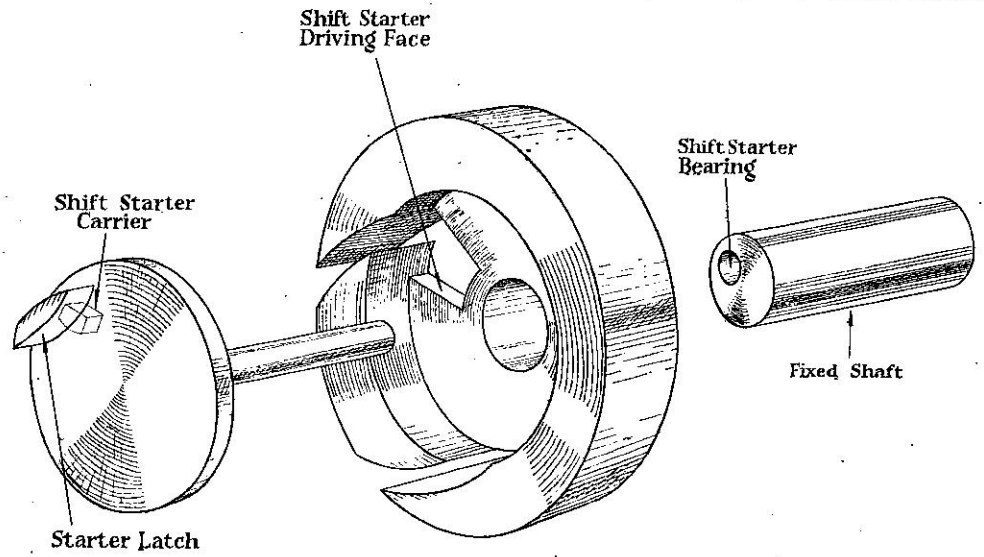


Figure 5.

should have given enough information in this article for the reader to plot his own version out on the drawing board. One warning I should like to give, is that one should be quite certain that one's methods of construction are quite sound before attempting either of these movements; for example, it is by no means easy to fix twelve *equally*-spaced pins in a plate. I as this is the easiest way of making them. In the whole job there is nothing which is beyond the capacity of an amateur with quite modest equipment, provided he is prepared to go to some pains. Should there be any point which is not quite clear, I am prepared to submit any further information by letter to THE MODEL ENGINEER.

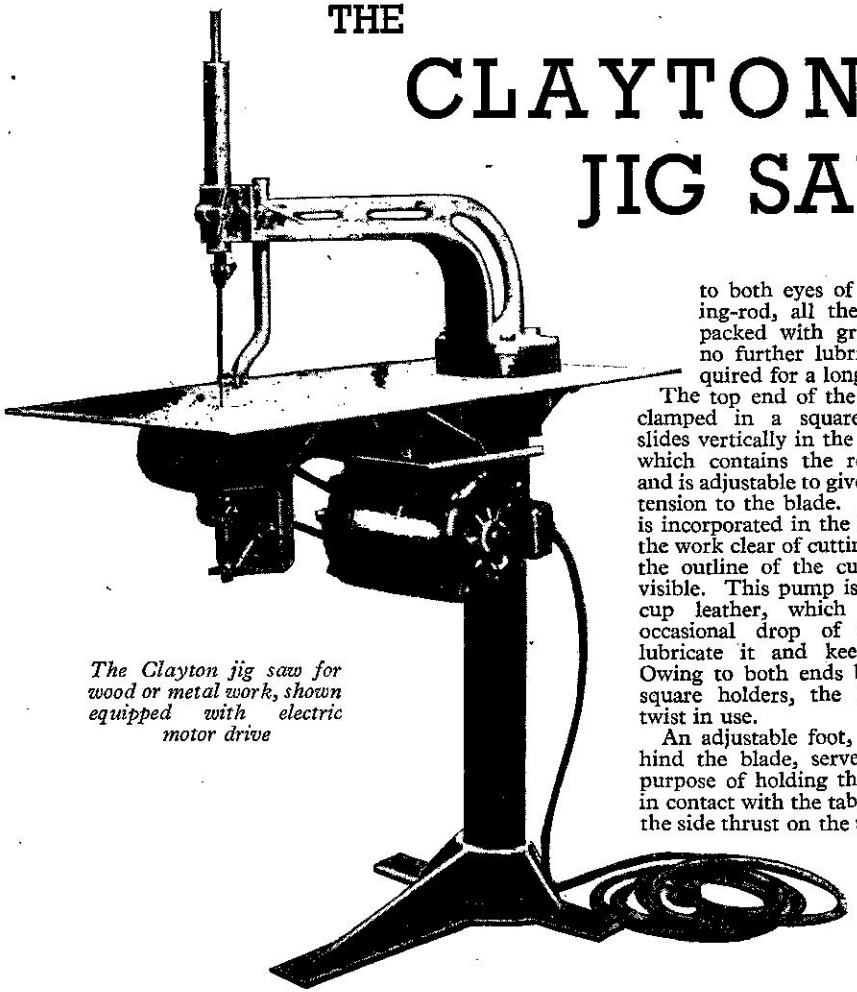
"L.B.S.C."

(*Continued from page* 64)

signal from Coulsdon station would suit my purpose, as it was a dinky little doings, with a ten-foot post, two-foot arm, eight-inch lamp, and in good condition, with counterweight and ladder all complete. If I took the ring off the arm, it would make a nobby main-line board for my railway. I said O.K., so he promised to have it taken down very carefully and let me have it. I duly received an invoice from the stores department for the parts of a scrap signal at a silly price, and am now awaiting delivery, at time of writing.

Working a full-sized signal automatically from a weeny railroad is going to be a bit of a teaser ; but as I am conversant with the operation of the electro-pneumatics on the Underground, and a tiny locomotive can bridge the running rails exactly the same as is done on 4 ft. 8½ in. gauge, I think we can do the job with an air cylinder worked by an electrically-operated valve. I guess there will be a few chyikes from the top of the bank, when the drivers and firemen see the signal's new location ; and probably the small kiddies who occasionally look through the railings, will want to come in, climb up the ladder, and light the lamp !

THE CLAYTON JIG SAW



The Clayton jig saw for wood or metal work, shown equipped with electric motor drive

WE have received from Messrs. Wassell & Clayton Ltd., Armada Works, 76, Trafalgar Street, Sheffield 1, particulars of an interesting jig-sawing machine which appears to have many useful applications in both wood and metal work, and should be of interest to model engineers, pattern makers, and instrument makers. The structure of the machine is mainly of light iron castings, and an unusually large table of steel plate, 14 in. wide by 30 in. long, is provided. There are 6 in. of table in front of the saw blade, and 15 in. between the blade and the arm casting, the table being extended back beyond this point to enable a vice or other fixture to be mounted on it.

The working parts are carried on a bracket below the table, and the blade is clamped to a square slide-rod which works vertically in bushed bearings. It is reciprocated by a light aluminium connecting-rod, and the crankshaft is mounted in two ball-bearings, which are housed in a tube with a spacing bush and dust caps at each end. Ball-bearings are also fitted to both eyes of the connecting-rod, all the races being packed with grease, so that no further lubrication is required for a long period.

The top end of the saw blade is clamped in a square rod which slides vertically in the tension tube, which contains the return spring, and is adjustable to give the required tension to the blade. An air pump is incorporated in the tube, to keep the work clear of cuttings, and allow the outline of the cut to be kept visible. This pump is fitted with a cup leather, which requires an occasional drop of light oil to lubricate it and keep it pliable. Owing to both ends being held in square holders, the blade cannot twist in use.

An adjustable foot, mounted behind the blade, serves the double purpose of holding the work down in contact with the table, and taking the side thrust on the saw blade. It is fitted with a hardened-steel grooved roller, adjustable to allow blades of various widths to be used.

The blade recommended for general light metal work is the "Eclipse Junior" hack-saw, which, when run at 700 strokes per minute, is suitable for cutting mild-steel up to $\frac{1}{8}$ in. thick; for steel of greater thickness, a slower speed is desirable, and may be obtained by means of a countershaft, which may be fitted or supplied as an addition, giving 250 or 180 strokes per minute. For woodwork, 900 strokes per minute can be obtained by fitting a smaller pulley on the crankshaft, the size of pulley recommended for metal being 4 in., and for wood 3 in. diameter. Electric motor drive is generally recommended, but it is also possible to drive the machine from a lineshaft, provided that this is fitted below the height of the table.

Owing to present shortage of supply, the makers cannot undertake to supply the machine fitted with a motor. It should be noted that for woodworking machinery of any kind, a licence is required when ordering. Special saw blades can be supplied for woodwork, which can be re-sharpened, when required, in the same manner as hand saws.

My Model Traction Engine

K. H. PRITCHARD

THE first model I have ever been connected with is the 2-in. scale working model compound traction engine, of which my father had been planning out after the last war. It has been in construction for a number of years, on and off, and built entirely from information obtained from one of Messrs. John Fowler's spare-part catalogues, and from photographs kindly supplied by Mr. Charles Fowler, who has taken an interest in the model. No attempt at accurate reproduction has been made in internal arrangements, though externally the "Fowler" type has been followed. My father has been responsible in its earlier stage and I did a lot in its final touches before being shown at THE MODEL ENGINEER Exhibition (Loan Section), in 1932. The model, I estimate, weighs 2 cwts.

Details

Locomotive-type copper boiler (coal-fired), 2 ft. long, barrel 6 in. diameter, lagged $\frac{3}{16}$-in. asbestos. Arrangement for paraffin firing, an extra tank for this being provided in the tender. I did the lagging and made the tank, based on Father's drawing. Two-speed gears are provided, with fool-proof interlocking device, so that only one dog-clutch can be engaged at a time. I assembled the device after a couple of hours' fitting it out. The ratio of the gears was exceptionally high, as Father did not give this point consideration when he began the work in 1918, and he told me that the ten phosphor-bronze gear wheels, specially made and cut for the engine, cost quite as much as he could afford! The balanced crankshaft was cut (at Saunders, Roes Ltd., of East Cowes, I.O.W., where Father used to work) from solid, the five steel tumblers of the eccentrics being keyed to the shaft.

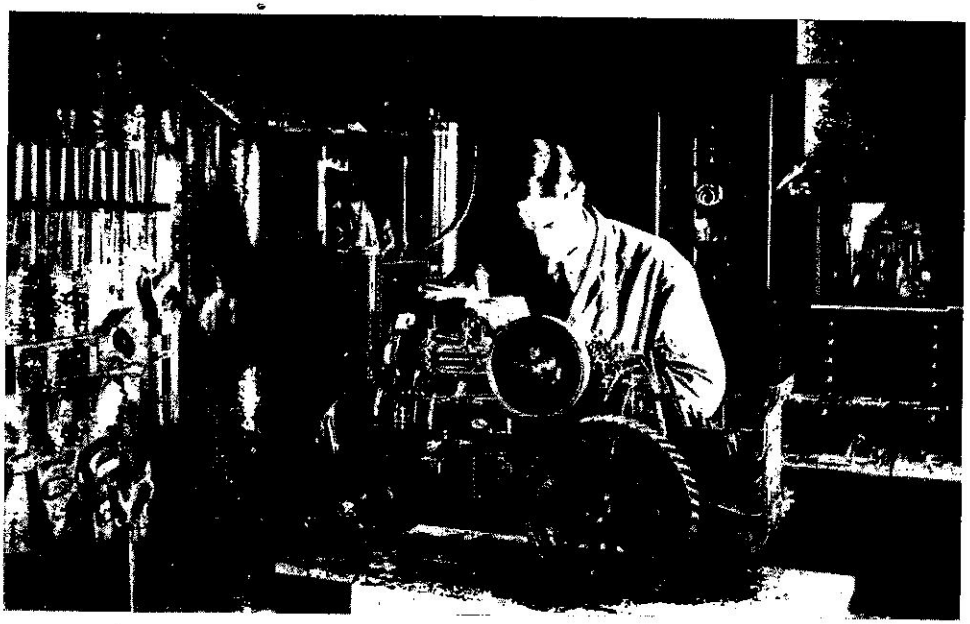
The governor operates a sleeve-valve in the regulating valve-chamber, a "booster" spring-valve being also provided, worked from the footplate to give a whiff of h.p. steam to the l.p. cylinder, when h.p. cylinder stops on dead centre, etc. I did the valve-setting after a couple of weeks, until it was in perfect working order, aided with compressed air working up to 60 lb. per sq. in. I made the air tank 2 ft. long and about 9 in. diameter.

A winding drum is secured on the main axle, which can be driven to form a winch by withdrawing the wheel-locking pins. This drum has its own hand-brake, which acts as an extra brake for the hind wheels when these are coupled to the axle.

I made the whole arrangement from my first attempted mechanical drawing. The main wheel brake blocks press on cast-iron rims, bolted to the spokes of the road wheels.

Differential is fitted to the wheel, being 9 in. diameter. There are two heavy steel bevel pinions in the gear. A special cowling was made to cover the whole gears, and I think it was one of the best precision jobs I have ever done.

The engine was tested with steam power and ran beautifully, like a real one. The experiment was so successful that I arranged



a special party of friends to come over and see the run with the engine on my twenty-first birthday. The engine naturally receives her name *Perseverance*.

The salient features of the engine are as follow :—Special castings used were, cylinder block, wheel rims, flywheel, and motion bracket, a spare-part catalogue of Messrs. John Fowler, of Leeds, being used as a guide for the arrangement of details. Other parts were made from "stock" metals and scrap.

Certain odd parts, *e.g.*, the smokebox door, was taken from an old-time Lanchester car, this door being the lid of the wick carburettor.

No attempt at exactitude of reproduction has been made. No novel features are incorporated, with the exception that dog-clutches in place of the ordinary intermeshing gear wheels are employed. "L.B.S.C.'s" practical notes in THE MODEL ENGINEER have been of help, and it may be of interest to mention that most of the raw materials, hand and machine tools, etc., were purchased from Messrs. Buck & Ryan, of Euston Road, London, N.W.1.

Specification.

Overall length	3 ft. 4 in.
Width over back wheels	1 ft. 0 in.
Height of the funnel from the ground	2 ft. 0 in.
Wheel base	1 ft. 10 in.
Bore, h.p. cylinder	1⅜ in.
Bore, l.p. „	2 in.
Stroke	2 in.
Weight (empty)	Approx. 200 lb.

In the photograph I am seen behind the engine, setting out the valve in our Stanmore workshop.

Letters

40 Years After

DEAR SIR,—It was very pleasant to see in a recent issue of THE MODEL ENGINEER the name of Frank Baines, and better still to find that he is still not only active in the model engineering line, but from the illustrations has lost none of his ability.

I have always regarded his 1½ in. scale "Stirling" G.N. 8 ft. 0 in. single, now, as he says, in the Science Museum, as amongst the finest half dozen jobs ever illustrated and described in THE MODEL ENGINEER; it can quite fitly rank with the work of the Coates Bros., and Dr. Bradbury Winter—I can give it no higher praise. It is indeed delightful to find after a lapse of over 40 years that such a master craftsman is still going strong; may he long continue to do so and be able to emulate the late Desvignes, who, unless my memory is at fault, was turning out first-class models when he was well over 80.

Yours faithfully,

Harrow. K. N. HARRIS.

Old Telegraph Instruments

DEAR SIR,—I should like to thank your correspondent, Mr. J. A. King, for his reply to my enquiry regarding "Old Telegraph Instruments."

The brevity of my description appears to have misled him into thinking that these instruments were somewhat similar to Wheatstone's "A.B.C." whereas actually there is no similarity, except, of course, that they were both "step by step" telegraphs. The "A.B.C.," which combined generator, transmitter and receiver in one instrument, was much larger, far more complicated and bore little external resemblance to mine, as the illustrations of it in "Herbert's" will show.

May I quote an abridged description of "Breguet's" instrument, taken from "An Elementary Treatise on Natural Philosophy," by "A. Privat Deschanel," of the Academy of Paris, a translation of which was published by Blackie and Son in 1872? (I can thoroughly recommend readers to have a look at this book if it is available at their local reference library; they will find much of interest therein, on many subjects) :—

STEP BY STEP TELEGRAPHS

"Telegraphs in which the ordinary letters of the alphabet are arranged around the circumference of a dial. One of the simplest is 'Breguet's' which is extensively used on the French Railways. The dial is inscribed with the 25 letters of the French alphabet and a cross. The hand, as in other step by step telegraphs, advances only in one direction, clockwise, stopping before each letter to be indicated and pointing to the cross at the end of each word. When current is sent an armature is attracted to a magnet, when current ceases a spring draws it back, and thus it vibrates continually during the transmission of a message. A fork attached to the armature vibrates about a horizontal axis carrying a pallet acting upon an escapement wheel, the number of teeth being 26. The wheel is driven by clockwork."

"Breguet's" differs from the instrument I have, in that mine has 26 letters, a cross and a space on the dial (28 positions in all), it operates anti-clockwise, the escapement has but 14 teeth, and is not operated by clockwork. Otherwise it is the same, even to the style of lettering on the dials, the design of the "call" bell, and, particularly, the "pointers" of both transmitter and receiver.

Incidentally, it may be of interest to remark that many other "step by step" telegraphs preceded Wheatstone's "A.B.C."; one was described in *Scot's Magazine* as early as 1753, only six years after the first known transmission of messages by electrical impulses over a length of wire. For serious work, however, they all gave way to the "Wheatstone Automatic System" (Wheatstone transmitters and Morse receivers) which, for so many years, was the backbone of British telegraphy, and despite the more recent advent of the teleprinter type of 5-unit-code apparatus, modern variants of the Wheatstone system still handle a goodly proportion of the world's telegraphic communications.

Yours faithfully,

"ENQUIRER."

Clubs

Oldham Society of Model Engineers

Our meetings will now take place on the second and fourth Fridays in each month, the next being on July 26th, when we shall hold a Jumble Sale. Meetings commence at 7.30 p.m. in the Co-operative Educational Building, Foundry Street, Oldham.

Hon. Secretary: W. K. BUCKLEY, 87, Lyme Terrace, Highfield, Mossley, Lancs.

Leicester Society of Model Engineers

On June 29th a very successful track meeting was held at the Orchard Model Railway, owned by F. W. Chapman, our president. A number of very interesting runs by locomotives owned by Mr. Chapman, Mr. Taylor and his son, and Mr. Wallis in 2½-in., 5-in., and 6-in. gauges were enjoyed by a large gathering of members and friends.

Owing to the rapid growth of membership it has become necessary to seek a larger room for our meetings. In future all meetings will be held at 33, Dover Street, Mr. Wallis very kindly again providing us with a more suitable room at his No. 2 Plant.

The next meeting will be held on Tuesday, July 23rd, at the new address, when the positions of chairman, vice-chairman and committee will be re-elected.

Hon. Secretary: E. DALLASTON, 67, Skipworth Street, Leicester.

The Andover and District Model Engineering Society

Since our inception in November, 1945, we have made remarkable progress and have recently secured, by the keenness of our president, Mr. D. Young, suitable premises as a workshop. When equipped, good use will be made of the long winter evenings and preparations made for the annual exhibition. Up to the present the members themselves have provided the interest at the instructional meetings. Talks on travel, lectures on "O" gauge model track and stock, model locomotives from 7½-in. to 3½-in. gauge, electricity (D.C.), and a quiz are some of many subjects covered. We are also intensely interested in the closer relationship of all model engineering societies in Hampshire and our near neighbours of Salisbury or Newbury and the Hon. Secretary will be pleased if any society interested will communicate with Andover. We would also welcome news from any source of a 6-in. centre lathe in good condition, and would send a representative to view same, if not too distant.

Joint Hon. Secretaries: R. PEMBLE, 14, Weyhill Road, Andover and F. VALLAT, 8, Walnut Tree Road, Andover.

The City of Bradford Society of Model and Experimental Engineers

Our next meetings will be, July 18th, Thursday evening, 7.30 p.m., at the Gladstone Club, "Work in Progress" meeting; this is your meeting, so bring a piece of that job you are doing. Remember that something which seems commonplace to you may be entirely new to another member, and will, therefore, add a bit more to his store of knowledge. July 24th, Wednesday evening, 7.30 p.m., at the works; a visit to the City of Bradford Electricity Department's Valley Power Station. Members wishing to attend should hand their names to the secretary at the meeting on July 18th. The maximum number is thirty, but a second visit will be arranged if there are sufficient names. Members should assemble at the main entrance in Canal Road.

Hon. Secretary: W. WOOD, 274, Hunsworth Lane, Cleckheaton.

Portsmouth Model Engineering Society

The very strong power boat section of the Society is holding successful meetings on the Canoe Lake, Southsea, on Saturday evenings and Sunday mornings, and any members from outlying clubs on holiday at Southsea will be assured of a welcome if they make themselves known at these meetings.

The old Portsmouth Model Steam Boat Club, recently amalgamated to the Society, is proving its worth by the way in which the members are combining and assisting in the very successful meetings.

Older members of the Portsmouth Model Steam Boat Club would like to hear from past friends, and a letter to the Hon. Secretary would be appreciated.

A visit was made recently to the General Post Office, to inspect the sorting department, automatic telephone exchange, and teleprinter rooms, and thanks are due to Lt.-Col. Hemsley, telephone manager, and Mr. Norris, who arranged the very interesting and enjoyable visit.

We have had a very fine lecture on the teleprinter, given by Mr. F. G. Walters, B.E.M., Post Office Engineering Department, London. This lecture lasting more than an hour, with a practical demonstration on teleprinters, provided and working through the courtesy of Mr. Norris, was one of the most interesting that the Society had had for some time.

The next monthly meeting, at the Central Library, on August 7th at 7.30 p.m., will be devoted to club business, and a film display on "Workshop Practice," by Cmdr. L. A. Brown, R.N.V.R. Visitors are welcomed to all meetings.

Hon. Secretary: H. A. HANDSFORD, 5, Milton Road, Copnor, Portsmouth.

NOTICES

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The Editor invites correspondence and original contributions on all small power engineering and electrical subjects, which should be addressed to him at 23, Great Queen Street, London, W.C.2. Matter intended for publication should be clearly written, and should invariably bear the sender's name and address.

Readers desiring to see the Editor personally can only do so by making an appointment in advance.

All correspondence relating to sales of the paper and books to be addressed to THE SALES MANAGER, Percival Marshall and Co. Ltd., 23, Great Queen Street, London, W.C.2.

Correspondence relating to display advertisements to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 23, Great Queen Street, London, W.C.2.

"THE MODEL ENGINEER"

SALES AND WANTS

Private: **Threepence** *word*. *Trade*: **Sixpence** *word*. *Use of Box* **2/6** *extra*. *Minimum charge*, **3/-**

TOOLS & WORKSHOP

Buck and Ryan's Department for Lathes, Drilling Machines, Grinders, Electric Tools, Chucks, Surface Plates, Lathe Accessories and Tools.—310-312, Euston Road, London, N.W.1. Telephone: EUSton 4661. Hours of Business: 8.30 to 5.0 p.m., Monday to Friday; Saturday, 1.0 p.m.

Split Chucks for Watchmakers' Lathes, 6 mm., 6½ mm., and 8 mm., at 7s. each, postage 6d.—JOHN MORRIS, 64, Clerkenwell Road, London, E.C.1.

"Tool News" keeps you up-to-date. Specimen copy 6d., post free.—GARNERS, Sheffield Road, Barnsley.

Wood Workers, Send S.A.E. for details of our new W.T. Lathe.—GARNERS, Sheffield Road, Barnsley.

"Adept" Super Lathe, perfect condition; 2 chucks, faceplate, driver, tools, with ⅓th h.p. A.C./D.C. 230 v. Motor, £12 10s.; also Steam Locomotive 0-4-2 Tank, two inside cylinders, reverse, displacement lubrication, twin paraffin "L.B.S.C." design burners; copper water-tube brazed boiler and all fittings, passenger hauler. Ideal for garden railway. Bargain, £27 10s.—ROWE, 25, Beulah Road, Rhiwbina, Cardiff.

Wanted, Lathe, 3½" Myford or similar, with or without motor and accessories. State price and particulars.—MOUNT, 35, Queenswood Road, Sidcup, Kent.

Sale, Two new ¼ h.p. B.T.H. Motors, 1,425/50c., 240/250 v., 1 phase, one solid base mounting, one resilient mounting. Crown 4" 3-jaw self-centring chuck, unused. Adept 2½" 4-jaw independent chuck for backplate fitting, unused. Offers.—SUMMERS, Arran, Broom Way, Oatlands Park, Weybridge.

Will Exchange for Power Jig Saw, brand new No. 1 Adept Bench Shaper.—CLOW, 107, Lane End Road, Heaton Mersey, Manchester.

Lathe, 4" Drummond, long bed, excellent condition, with all accessories, £30. View by appointment.—115, Bourne Way, Hayes, Kent.

Corbett's (Lathes) Offer from stock or early delivery, Atlas Lathes and accessories (other lathes available), 1/3 h.p. B.T.H. Motors, "Record" Engineers' and Woodworkers' Vices, five-speed motorised 0-½" Bench Drills, double ended Bench Electric Grinders, 1/3 and ¾ h.p., Moore & Wright Micrometers, etc. Send S.A.E. and state requirements. Telephone 583 Sutton-in-Ashfield.

Woodworking Lathe, 5" centres, 36" bed, very completely equipped, brand new, £14 10s.; coal-fired locomotive boiler, 4" barrel, 12" overall, copper, 30s.; Model Yacht, 3 ft. long, 4 ft. mast, £5; Generator Delco Remy, 26 v., 10 amps. D.C., as new, 35s.; Treadle Grinder, 6" stone, 20s.; 12 v. Rotax Starter Motor, 20s.; Brand new Starrett 4" to 5" and 5" to 6" Mikes, 70s. each. S.A.E.—ROGERSON, Bookers Cottage, Downside, Colham, Surrey.

Myford 3½" Bench Lathe, motorised. Offers.—13, Churchill Avenue, Kenton, Middlesex. Wordsworth 6544.

Lathes Wanted, all Sizes—Also Shapers, Bandsaws, Universal Miller, Surface Grinder.—VICTA ENGINEERING COMPANY, Maidenhead. Telephone 50.

For Sale, 3½" Drummond Lathe with accessories; 3" Zyto Lathe, S.C. and accessories.—B., 62, St. Maur Road, Fulham. Ren 2734.

Sale, 5" Wolf Jahn Precision Lathe 24" centres, on stand, with 4" Cushman 3-jaw, collets ¼"-9/16", compound slide-rest, etc. View S.E. London by appointment. Offers.—Box No. 4065, MODEL ENGINEER Offices.

Wanted, 3½" Drummond or similar B.G.S.C. Lathe on stand. State condition.—G. HAZELWOOD, Pound Hill, Sussex.

3 Ft. Lathe Bed, 50s.; 4" Chuck, 40s.; metre M.T.B., steam, fast, £15. Full list tools, models, stamp.—HUGHES, 23, Reighton Road, E.5.

B. Draper & Son, 1, Grange Road, Kingston-on-Thames, have a good selection of used Machine Tools, including Bench Lathes, Motorised Drilling Machines, Shapers, Grinders, Millers, etc., also large stocks of new Machine Tools and Small Tools. Send for detailed list or call and inspect our stocks. 'Phones: Kin. 1191/2 and 1595.

Wanted, Tools, Models and Equipment for starting workshop. Good lathe, steam locomotive up to 7½", stationary and marine engines, etc.—80, Ridgeview Road, London, N.20.

For Sale, Quantity 14-g. bright M.S. Plates, 6" by 5 ft. Ideal for model work, 2s. 6d. per sheet, 9 for 21s., carriage extra. Weight approx. 8 lb. per sheet.—E. BENNETT, 40, Plough Hill, Cuffley, Herts.

Wanted, 5"-6" S.S.S.C. Lathe for rough operation. Condition not important. Must be cheap. Particulars—R. URIE, 26, Torcross Road, Ruislip, Mx.

Files, 4", 6", 8", 10", 5s., 6s., 8s., 10s. per doz., assorted if required, in hand, flat square, 3-square round, and square bastard, smooth, 2nd cut warding or thin flat, 4 to 6", 5s. doz., carriage paid.—W. STACEY, Dept. M.E., 6, Mary Street, Sheffield.

Steel Nuts, 2 and 4-B.A., 1s. 6d. gross; Steel Screws, 2, 4, 6-B.A. CH., Csk., Hex., Rd., ⅜"-1", 2s. gross; collection, hardly used, Milling Cutters, Drills, End Mills, Reamers, prices quoted. Turning Bits, 1s. 3d., 1s. 6d. each.—HINCKESMAN, 48, Dibdale Rd., Dudley.

For Sale, Brand new Super "Adept" Lathe, angle-iron stand, foot motor and equipment. Present day price £10 or offers. S.A.E., please.—CLARKE, Wood Cottage, Faygate, Horsham, Sussex.

MODELS & FITTINGS

Locomotive Cylinder Castings, bore to 1¼", steam chests, covers, eccentrics, buffers, hornblocks. All gunmetal. "Hielan' Lassie" steel frames, slots and gaps cut. Spot drilled if required. Flywheel castings, 2⅜" × 7/16", gunmetal. S.A.E. please.—KENDALL, 106, Rugby Road, Binley, Coventry.

Apex and New Atom Minor (Mr. Westbury's design). Engine castings of DTD 424, the famous alloy as used in Rolls Royce Aero engines, Sp gr. 2.56. Tensile 9 tons, lighter and far stronger than die cast, with most attractive finish. Carburettor castings (described June 14th issue "M.E."), and spiral timing gears for Apex; Ball-races, piston rings, miniature plugs, contacts and other equipment. Send us your enquiries. Trade also invited.—THE HEADINGLEY MOTOR & ENGINEERING CO. LTD., 8, Otley Road, Leeds.

Australian Designs, Engines, Locomotives, catalogues, 2s.—BOLTON, 70, King Street, Sydney.

Wanted, Gauge "O" Steam or Clockwork Locomotive, Rolling Stock and brass or stainless steel rails. Details and price to—Box No. 4060, MODEL ENGINEER Offices.

Sale, Castings for Stuart Compound Engine, 2½" and 4" × 3" stroke.—12, Swarland Avenue, Longbenton, Newcastle-on-Tyne.

Sale, Stuart Compound Launch Engine, ⅜" by 1½", also Donkey Pump. Stamp, particulars.—WEBSTER, Oak House, Shawforth, Rochdale.

Stuart Turner "Meteor" Steam Engine with displacement lubricator; also small boiler and spirit lamp. Offers.—ALLEN, Holbrook A., Hampton Park, Hereford.

Model Yacht, "Jonquil," 2 mast, fully rigged, on stand. Hull 33" × 7", £3 10s.—Rose Cottage, High Street, Selsey, Sussex.

Wanted, Complete Propulsion Unit for Cabin Cruiser, 3' 3" l.g.—BROWN, Allendale, Mountfields Drive, Loughborough.

½" Scale L.N.E.R. Passenger Rolling Stock, various, with additional odd items—50 ft. brass Vignoles track laid on strong boards, also quantity loose rail. S.A.E. or inspection.—FARTHING, 33, Bell Street, Edgware Road, London, N.W.1.

Bassett-Lowke Working Scale Model Traction Engine.—Box No. 4063, MODEL ENGINEER Offices.

For Sale, 1" M. & W. Mike, never been used, 28s.; Oscillating Engine and Boiler, 10s.; A. M. Bell's "Locomotives" and complete set of prints for "L.B.S.C." "Green Arrow," £2. Both above have never been used. Postage extra.—68, Bates Street, Sheffield 10.

Sale, Model Tram Car, 30 volts, 3½ ft., £15.—HARRISON, 155, Bilford Road, Worcester.

Can Anyone Oblige Ex-Serviceman with Castings or Materials for "Miss Ten to Eight"? One partly constructed considered.—51, Springfield Road, Baildon, Yorkshire.

Electric Scale Model of Swiss Railway Locomotive, 20 v. A.C., gauge "O," weight 9½ lb., height 4½", length 15½", complete with 3 carriages, new, £60. Apply—26, Glenavon Road, Stratford, E.15, or 'Phone Maryland 1611.

3½" 4-4-2 Frames, Wheels, Axles, Bogie Eccentrics, finished boiler barrel, flanged plates, some tubes, cylinder castings, etc., £10; S.A. Twin Engine, requires refit, 30s. Exchange lot Rainhill Locomotive.—2, Farnon Road, Gosforth, Newcastle-on-Tyne.

For Sale, "A" class, 6 metre Model Yacht, 4 suits of sails (one 1st suit Perks' XL), with case; detachable keel, recently renovated, better than when built. Designed by Daniels, Member Y.M. 6-m. O.A., £45. Can be seen at Nielson's, 48, High Street, Kingston-on-Thames.

Pressure Gauges, ½" and 1" diameter, with nut and liner, 150 lb., well-known make, 12s. 6d. each. Satisfaction or money back. Cash with order. Delivery 8 weeks certain.—S. GIRLING, 32, Barbara Road, Hall Green, Birmingham 28.

5" Gauge 4-4-0 Locomotive and Tender. Trial by appointment, £100 or best offer.—CURWEN, Gore Lane, Baydon, Nr. Marlborough.

½" Water Gauge, 5s.; ¼" Check Valve, 4s.; ½" Globe Valve, 8s.—THOS. MCCRACKEN, 388, Main St., Rutherglen.

Model Sailing Barque, Fast, easily handled, beautifully fitted, very uncommon, £30 or near.—DEAN, 46, Eltham Road, S.E.12.

"Hielan' Lassie" Locomotive Castings to "L.B.S.C." specification; piston valve cylinders, inside and outside motion brackets, all wheels.—HASELGROVE, 1, Queensway, Petts Wood, Kent.

ELECTRICAL EQUIPMENT

Electradix Bargains include:—

Dynamo and Motor Generator Bargains, G.E.C. double current Dynamos, 6 volts, 5 amps., 600 volts, 80 m.a., ball-bearings, 17 lb., as new, 37s. 6d., carriage paid, 5s. refunded on returned packing case.—Below.

Small D.C./D.C. Motor Generators by leading makers for use in Radio Receivers to take the place of H.T. battery, 6 volts input, 110 volts, 15 m.a. output, or 12 volts input, 230 volts, 30 m.a. output, £3 15s., weight only 5½ lb., size 5½" × 3½" × 3½", model finish, ball bearings, 2-comms., 2 separate windings, waterproofed.—Below.

Transformers, 3 K.W. Crypto, 230 volts to 115 volts, 28 amps., £9 10s.; to small Bell Transformers, 230/3/58 volts, 7s. 6d. Transformers for Rewind, 3 K.W. with stampings, 4½" × 6" × 7½", windings damaged by blitz, weight with damaged wire, 65 lb., 45s., carriage extra.—ELECTRADIX, 214, Queenstown Road, London, S.W.8.

D.C. Motors, ¼ h.p., 200/250 volts, £6 18s. each; ⅓ h.p., £3 15s. each. Many others.—JOHNSON ENGINEERING, 319, Kennington Road, S.E.11. RELiance 1412/3.

Best Bargain Yet! Large number of brand new Rotax Dynomotors, 24 v., delivering 95 v., with high amps. Will work on 12 and 6 v. Could possibly be made into welding plant, or as a motor for driving machinery, very powerful. Cost Gov. originally £30, now at a gift £1 5s. each, including carriage.—EMMS, 68, "Redcliffe," Old Brompton Road, S.W.5. Flaxman 3634.

"Pigmy" Electric Motors for Boats, fans, etc., 2½" × 2" × 1¾", 10 ozs., A.C./D.C. 4/24 volts, flashlamp batteries, accumulators, transformer, send 25s. 7d. EDUCATIONAL MANUFACTURING COMPANY, 197, Brownshill Green Road, Coventry.

New H.T. Eliminator (200/250 V. A.C.), output 60/90/120 V., 15 m.a., 55s.—JOLIFFE, Aston Clinton, Bucks.

For Wires, Electrical Supplies.—SCOTT of Chard, The Model Makers' Electrical Stores.

Graham Farish Electric Fire, 100 v., 500 w., 22s. 6d.; Pint Blowlamp, 10s. 6d.; Tow-bar attachment for Ford 8, 22s. 6d. and carriage.—7, Burgh Wood, Banstead, Surrey.

GENERAL

Watch and Clock Making. If interested you can get all tools and parts, also wheels cut from—JOHN MORRIS, 64, Clerkenwell Road, E.C.1. Regret no posts or lists, only counter service at present.

Watchmakers Demobbed need Lathes to start work again. John Morris (Clerkenwell) Ltd., will pay high prices for Lathes by Lorch, Boley, Wolf Jahn, and American and Swiss makes.—64, Clerkenwell Road, E.C.1. CLE 6077.

Transfers for Decorating Toys, Trays, Furniture, Fancy Goods. Selection 10s., 20s. Flowers, Pixies, Dogs, Nursery Rhymes.—ME. AXON, HARRISON, Jersey.

Blueprints. Henry Greenly's world-famous drawings, locomotives, rolling stock, etc. Send for list, 2½d., stating gauge.—HENRY GREENLY, 66, Heston Road, Heston, Middx.

New Steam Engine Drawings. Send P.C. for details.—DRABBLE & SONS, 10, Ashton Drive, Hunt's Cross, Liverpool. Trade enquiries invited.

Blueprints or Problems, results are obtainable with working drawings by Underhill, Wilson, Greenly, Skinley, Stuart Turner, and advice from a practical model engineer; latest being Racing Yacht, Centre Flue Boiler, Blowlamp, Liner "Stirling Castle," Destroyer "Cossack," Clipper "Stonehouse." Quotations 2½d. stamp. Advice 3s. 6d.—WILSON, MACDUFF & CO. LTD., 5, Victoria Street, London, S.W.1.

Drawings Prepared from Inventors' Sketches, Descriptions, utmost secrecy observed. Large library of rare books permits accurate preparation of drawings for old engines.—LADBROOKE, "Adare," 1st Close, Clabon Road, Norwich.

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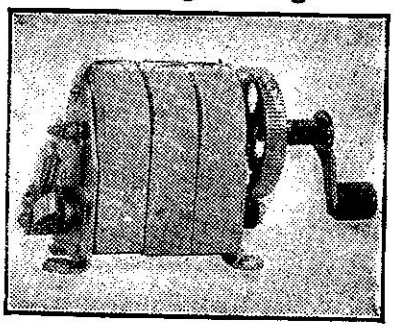

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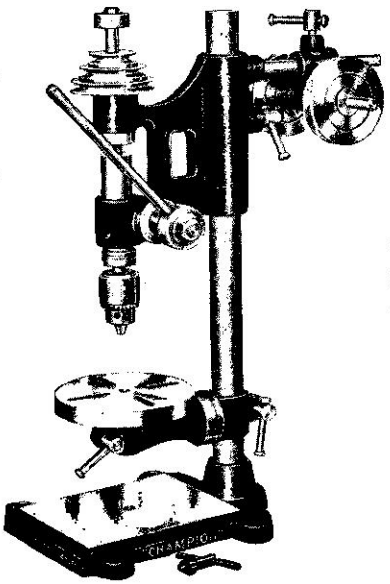

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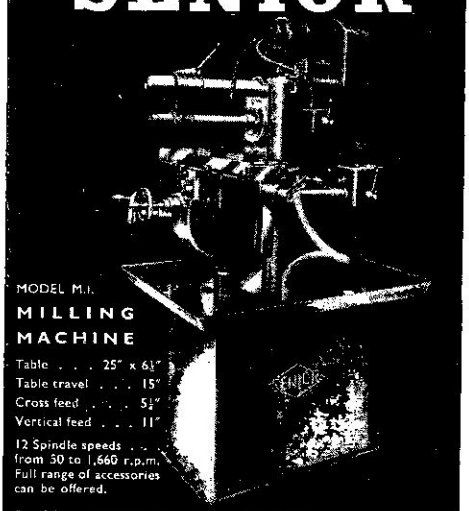

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